Report To Congress On The Relationships Between Projects Selected For The Clean Coal Technology Program

And

The Recommendations Of The Joint Report Of The Special Envoys On Acid Rain

October 1986

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Washington, D.C. 20585

EXECUTIVE SUMMARY

This report describes the projects selected by the U.S. Department of Energy (DOE) under the Clean Coal Technology (CCT) Program and their degree of compatibility with the technology demonstration program recommended in the Joint Report of the Special Envoys on Acid Rain (JRSEAR). At the outset, it should be recognized that Congress directed the CCT Program to demonstrate a broad spectrum of coal technologies, in response to a diverse set of environmental, economic, and energy security goals. In contrast, the program recommended by the JRSEAR was sharply focused on technologies with the singular objective of reducing the adverse effects of acid rain. Nevertheless, in meeting the Congressional mandate, DOE selected several technologies which are believed to also meet the criteria set forth in the JRSEAR.

Criteria for the CCT Program are set forth in the legislative history of the law authorizing funds for the program. This history includes the following statements:

- "... that the solicitation be open to all markets utilizing the entire coal resource base."
- "[it is] imperative to demonstrate technologies that use coal cleanly and efficiently, so that needed generating capacity will be available on time, and with minimal environmental impact."
- "Technology that can be retrofitted to existing applications of coal will also provide pollution relief. Clean uses of coal in other applications will also reduce dependence on foreign oil as well as increase coal markets."
- "... other [non-utility] applications such as industrial, including steel and iron ore processing, and transportation uses are also of interest."

Congress specified that the demonstration must have at least 50% private sector funding.

The JRSEAR also identified several criteria for selecting demonstration facilities, including:

- The most important goal was to expand the slate of available technologies to control SO2 and NOx. Implicitly, a major objective was demonstration of less expensive technologies that could be used to control suspected acid rain precursor pollutants.

- o A secondary goal was near-term emission reductions, and the report places special consideration on:
  - projects which could get the greatest reductions in SO2 and NOx;
  - among projects with similar potential, funding should go to those with maximum cost effectiveness (least cost per ton of controlled pollutant);
  - projects that demonstrate retrofit technologies applicable to the largest number of existing sources especially those that because of their size and location, contribute to transboundary air pollution.
  - technologies that can be applied to facilities currently dependent on the use of high sulfur coal.

The JRSEAR also recommended 50% funding by the private sector.

Hence, although the CCT Program had other goals in addition to the objective of providing technologies to reduce acid rain, in the area of acid rain the CCT Program objectives have much in common with the JRSEAR objectives. These common goals center on a desire to seek private sector participation in expanding the slate of economically competitive technologies which can control SO2 and NOx.

Table S-1 displays the degree to which the nine selected CCT Program proposals meet the criteria set forth in the JRSEAR. It is important to note that these technologies generally represent fundamental departures from current control technology approaches (i.e., they expand the slate); all but one are capable of using high sulfur coal; all but one are in areas believed to contribute to transboundary air pollution (see Figure 1); and several are appropriate for retrofitting or repowering (replacing) existing facilities.

Furthermore, many of the selected technologies have applicability to new sources, either in addition to retrofit application or instead of retrofit application. Although the JRSEAR emphasized retrofits (but did not exclude new source applications), it must be recognized that long-term improvements in emission rates will result only from use of more effective pollution control systems than currently exist (see Figure 3). About one-half of the selected technologies can reduce emissions of SO2 or NOx to levels less than 50% of currently allowed emission rates for new sources.

In summary, this report concludes that many of the technologies selected under the CCT Program are consistent with technologies which would have been selected if one followed the recommendations in the JRSEAR. The CCT Program also includes other technologies, consistent with the broad Congressional mandate

which created the program. These other technologies also should assist in the longer term reduction of suspected acid rain precursor pollutants.

TABLE S-1

COMPARISON OF CCT PROJECTS TO SPECIAL ENVOYS RECOMMENDATIONS

OFFEROR NAME:	ABBREVIATED TITLE	RECOMMENDATION 1			PARTIAL RECOMMENDATION 2	PARTIAL RECOMMENDATION 3	RECOMMENDATION 4
		APPLICABLE TO UTILITIES	EMISSION REDUCTION		ECONOMIC IMPROVEMENTS	APPLICABLE TO RETROFIT	USE HIGH SULFUR COAL
			DEMO	COMMERCIAL			
AMERICAN ELECTRIC POWER SERV.	TIDD PFBC DEMO PLANT	Y	Y	Y	Y	Y	Y
THE BABCOCK & WILCOX COMPANY	LIMB DEMO PROJECT EXTENSION	Y	Y	Y	Y	Y	Y
COAL TECH CORPORATION	ADVANCED CYCLONE COMBUSTOR DEMO	Y	N	Y	Y	Y	Y
ENERGY & ENVIRONMENTAL RESEARCH	GAS REBURNING/SORBENT INJECTION	Y	Y	Y	Y	Y	Y
ENERGY INTERNATIONAL, INC.	UCG/CLEAN FUELS PROOF-OF-CONCEPT PROJECT	Y	N	Y	Y	N	N
GENERAL ELECTRIC COMPANY	INTEGRATED GASIFICATION-STEAM INJECTION GAS TURBINE	Y	Y	Y	Y	N	Y
THE M.W. KELLOGG COMPANY	THE APPALACHIAN PROJECT	Y	N	Y	Y	Y	Y
OHIO ONTARIO CLEAN FUELS INC.	COAL-PETROLEUM COPROCESSING PLANT	Y	N	Y	Y	N	Y
WEIRTON STEEL CORPORATION	KR IRONMAKING DEMO PLANT	N	Y	Y	Y	N	Y

Notes:
- Recommendations listed on page ii and iii.
- Recommendation 3 also relates to location of the demonstration; a map of demonstration project locations is provided in Figure 1.
- Recommendation 2 cannot be directly addressed by publicly available data.
- Y indicates yes; N indicates no.

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1.0 Background

1.1 Joint Report of the Special Envoys

In March 1985, President Reagan and Prime Minister Mulroney appointed Special Envoys Drew Lewis of the United States (U.S.) and William Davis of Canada to assess the international environmental problems associated with transboundary air pollution, and to recommend actions that would help to solve them. In order to support this overall responsibility, the Special Envoys were assigned four specific tasks:

1. to pursue consultation on laws and regulations related to pollutants thought to be linked to acid rain;

2. to enhance co-operation in research efforts, including research on clean fuel technology and smelter controls;

3. to pursue means to increase exchange of relevant scientific information; and

4. to identify efforts to improve the U.S. and Canadian environments.

The Joint Report of the Special Envoys on Acid Rain (January 1986) resulted from these efforts. In the report, the Special Envoys concluded that acid rain is a serious environmental problem in both the United States and Canada, that acidic emissions transported through the atmosphere undoubtedly are contributing to the acidification of sensitive areas in both countries, and that the potential for long-term socio-economic costs is high. Further, it was concluded that acid rain is a serious transboundary problem. Concerning potential solutions to the acid rain problem, the Special Envoys concluded that, at the present time, there are only a limited number of potential avenues for achieving major reductions in acidic air emissions, and they all carry high socio-economic costs. In particular, the Joint Envoys' Report noted that none of the conventional methods now available for controlling emissions provide a simple solution to the problem. Coal washing cannot eliminate enough SO2 to achieve a major reduction; coal switching would cost high-sulfur coal miners their jobs; flue-gas scrubbing will raise utility rates sharply.

The report contained a number of recommendations for actions to be taken to mitigate the problem, including a recommendation that the U.S. government implement a five-year, five-billion-dollar cost-shared control technology commercial demonstration program in which the federal government would provide one half of funding for projects recommended by industry sponsors who would contribute the other half of the funding. The proposed program was to be part of a long-term response to the transboundary acid rain problem.

The following specific criteria were recommended for use in the evaluation of projects for the proposed program:

- The Federal government should co-fund projects that have the potential for the largest emission reductions, measured as a percentage of SO2 or NOx removed.
- Among projects with similar potential, government funding should go to those that reduce emissions at the least cost per ton.
- More consideration should be given to projects that demonstrate retrofit technologies applicable to the largest number of existing sources, especially existing sources that, because of their size and location, contribute to transboundary air pollution. And, although primary program emphasis would be placed on the demonstration of the kinds of technologies that would be needed for any future acid rain control program, it should also result in some near-term reductions in U.S. air emissions that affect Canadian ecosystems.
- Special consideration should be given to technologies that can be applied to facilities currently dependent on the use of high-sulfur coal.

See Appendix B for pertinent excerpts from the Envoys' report.

1.2 Clean Coal Technology Program

The United States Congress made $400 million in funds available for the Department of Energy (DOE) to undertake a Clean Coal Technology (CCT) Program with the objective of conducting cost-shared clean coal technology projects for the construction and operation of facilities to demonstrate the feasibility for their commercial applications. An Act Making Appropriation for the Department of the Interior and Related Agencies for the Fiscal Year Ending September 30, 1986, and for Other Purposes, Public Law 99-190 (December 19, 1985) provided funds "... for the construction and operation of facilities to demonstrate the feasibility for future commercial applications" of such technologies and directed the Secretary of Energy to undertake the program. The $400 million taken from the Energy Security Reserve is "... to remain available until expended, of which $100,000,000 shall be immediately available; (2) an additional

$150,000,000 shall be available beginning October 1, 1986; (3) an additional $150,000,000 shall be available beginning October 1, 1987." However, Section 325 of the act reduced each amount of budget authority by 0.6 percent, so that these amounts became $99.4 million, $149.1 million, and $149.1 million, respectively, for a total of $397.6 million. As shown in Table 1, additional deductions were made to establish a Cost Overrun Reserve ($25 million), support the Small Business Innovative Research Program ($4.9 million) and to provide for support of operating expenses ($5.5 million). The total amount of funds available for awards is $362.2 million.

In response to the Congressional mandate, on February 17, 1986, DOE issued a Program Opportunity Notice (PON) "... to solicit proposals to conduct cost-shared clean coal technology projects to demonstrate the feasibility of these technologies for future commercial applications." There were a number of Congressional guidelines for the program (refer to Appendix C for a legislative history). For example, it was stated in the Conference Report on Public Law No. 99-190 that:

- "It is the intent of the managers that there be full and open competition and that the solicitation be open to all markets utilizing the entire coal resource base. However, projects should be limited to the use of United States mined coal as the feedstock and demonstration sites should be located within the United States."

Also, in House Report No. 99-205, Department of the Interior and Related Agencies Appropriation Bill, 1986 the following statements were made:

- "Air pollution, particularly acid rain, is a problem of growing concern in the Nation, In addition, significant new generating capacity will be required by utilities in the 1990's. In view of the collapse of the nuclear construction industry, the only viable alternative appears to be coal-fired plants. Therefore, it becomes imperative to demonstrate technologies that use coal cleanly and efficiently, so that needed generating capacity will be available on time, and with minimal environmental impact. Technologies that can be retrofitted to existing applications of coal will also provide pollution relief. Clean uses of coal in other applications will also reduce dependence on foreign oil as well as increase coal markets."

- "Many sources in Congress and elsewhere have been suggesting technical or procedural criteria for the selection of projects, and in general, the criteria suggested appear reasonable. The Committee observes that the criteria tend to concentrate on utility applications, and believes that although these are very important, other applications such as industrial, including steel

TABLE 1

Budget for the Clean Coal Technology Program

	(Thousands of dollars)		
	FY 1986	FY 1987	FY 1988
Congressional Appropriations	$99,400	$149,100	$149,100
Overrun Reserve	6,250	9,375	9,375
SBIR Program	1,226	1,837	1,837
Operating Expenses	1,491	1,988	1,988
Net Monies Available for Award	$90,433	$135,900	$135,900

and iron ore processing, and transportation uses are also of interest. The preparation of clean coal fuels is also important in itself."

- "The Committee believes that this program can be a significant step in reducing the environmental effects of coal burning, in increasing power generation options, in introducing new coal burning equipment, and in increasing markets for coal and coal-derived products, which will offset oil imports in the future."

Finally, submissions were to present projects to be performed by industry, with financial assistance available from the government at levels up to 50 percent of the project cost.

In response to the PON, DOE received 51 proposals to design, build, and operate projects to facilitate the clean use of U.S. coals in the nation's utility, industrial, and other market sectors. From these proposals, DOE has selected nine projects for negotiations. The nine projects are:

Sponsor	Technology	Project Location
American Electric Power Service Corporation Columbus, OH	Pressurized Fluidized Bed Combustion Combined Cycle Utility Retrofit	Brilliant, OH
Babcock & Wilcox Alliance, OH	Extended Tests of Limestone Injection Multistage Burner Plus Sorbent Duct Injection	Lorain, OH
Coal Tech Corp. Merion, PA	Slagging Combustor with Sorbent Injection into Combustor	Williamsport, PA
Energy and Environmental Research, Corp. Irvine, CA	Gas Reburning & Sorbent Injection retrofit into three utility boilers	Springfield, IL Hennepin, IL Bartonville, IL
Energy International, Inc. Cheswick, PA	Steeply Dipping Bed Underground Coal Gasification Integrated with Indirect Liquefaction	Rawlins, WY
General Electric Co. Cincinnati, OH	Integrated Coal Gasification Steam Injection Gas Turbine Demonstration plants (2) with Hot Gas Cleanup	Evendale, OH Dunkirk, NY
The M.W. Kellogg Co. Houston, TX	Fluidized Bed Gasification with Hot Gas Cleanup Integrated Combined Cycle Demonstration Plant	Cairnbrook, PA
Ohio Ontario Clean Fuels, Inc. Poland, OH	Coal-Oil Coprocessing Liquefaction	Warren, OH
Weirton Steel Corp. Weirton, WV	Direct Iron Ore Reduction to Replace Coke Oven/Blast Furnace for Steelmaking	Weirton, WV

Appendix A contains summaries of these nine selected projects.

It is possible that a cooperative agreement may not be executed with one or more of the entities in this group of nine. Therefore, fourteen alternate proposals have been identified which would then be considered in this eventuality. If for any reason an agreement is not executed with any of the nine selected applicant(s), the federal share of funds originally designated for those project(s) would become available to support one or more replacement project(s). No predetermined selections have been made among the fourteen alternate projects. If and when it becomes appropriate, the PON evaluation criteria and program policy factors will be applied to select alternative projects for negotiations of award.

1.3 Intent of CCT Program as Compared to Recommendations of Special Envoys' Report

As shown in Table 2, the focus and intent of the CCT Program and the innovative control technologies recommendations of the Joint Report of the Special Envoys have significant differences although there are also considerable commonalities. As previously discussed, the CCT Program was open to all clean coal technologies, for all energy market applications, including both new and retrofit use and using the full U.S. coal resource base. On the other hand, the recommendations of the Joint Envoys' Report focus on those control technologies which: (1) have the potential for the largest emission reductions (measured as a percentage of sulfur dioxide or nitrogen oxides); (2) result in reduced emissions at the lowest cost per ton; (3) are for all applications with priority given to retrofits which apply to the largest number of existing sources, but especially to existing sources that contribute to transboundary air pollution, and would result in some near-term reductions in U.S. air emissions that affect Canadian ecosystems; and, (4) can be applied to facilities currently using high sulfur coal. As a result, it is not to be expected that each CCT project chosen will satisfy the Joint Envoys' requirements, although as discussed later, all of the projects selected will potentially satisfy the intent of both the CCT Program and the Report recommendations to some degree.

TABLE 2

Comparison of Major Emphases of the

CCT and Special Envoys' Programs

Program	Markets	Application	Coal Type	Environmental Requirements	Economic Requirements	Energy Aspects
CCT	All	New and/or retrofit located anywhere in U.S.	All	Meet and/or exceed current requirements	Economically competitive under current or more stringent regulations	More efficient use of coal, potential displacement of oil and natural gas, and retention of markets for all types of coal including high sulfur
Special Envoys	All, but special consideration to largest number of existing sources that, because of size and location contribute to transboundary air pollution	All, except more consideration to retrofits which because of size & location contribute to transboundary air pollution	All, but special consideration to high sulfur	Near term emissions reductions from demonstration; greatest % SO2 and NOx emissions reductions from present facilities	Cheapest cost per ton of pollutant reduction, within the environmental requirements	Retain existing high-sulfur coal use

2.0 Relationship Between CCT Selections and Recommendations of Special Envoys on Acid Rain

2.1 Key Features of CCT Selections

The CCT Program Opportunity Notice (PON) was based on the legislative guidance which accompanied the appropriations. As noted in Section 1.2, this guidance directed DOE to solicit technical demonstrations which represented the entire spectrum of coal use. The PON provided broad flexibility in defining the type of project for which a proposal could be submitted. As a consequence, the nine projects selected exhibit substantial diversity in terms of such dimensions as technologies embraced, project scale, geographic distribution, user sector to which the technology would apply, and type of coal used.

The nine projects selected can be sorted into seven major technology categories: Two of the projects, one offered by the M.W. Kellogg Company and the other by the General Electric Company, are in the surface gasification category. Two projects, one offered by the Babcock & Wilcox Company and the other by Energy & Environmental Research, are classified as flue gas cleanup technologies. The remaining projects include offers by the American Electric Power Service Corp. for a pressurized fluidized-bed boiler technology; by Ohio Ontario Clean Fuels Inc. for coal-petroleum coprocessing involving liquefaction technology; by Coal Tech Corporation for an advanced combustion technology and by Energy International for an in-situ (underground) coal gasification process. The project offered by Weirton Steel Corp. is an industrial process for the direct reduction of iron ore to produce hot metal.

2.1.1 Environmental, Technical and Economic Advantages

The nine projects selected for the CCT Program offer many technical and economic advantages over the conventional technologies they are expected to replace. The following summarize some of those advantages.

2.1.1.1 Advanced Combustion

The Coal Tech Corporation offering titled "Advanced Cyclone Combustion Demonstration" is for a 1000 hour test to demonstrate the performance of an advanced, air-cooled, cyclone combustor using dry pulverized coal, retrofitted to a 23 million Btu/hr boiler designed for oil use. The technical performance objectives of the proposed project are to demonstrate: (1) 90 to 95 percent coal ash retention in the combustor (and subsequent rejection), (2) NOx reduction to 100 parts per million or less, (3) sulfur oxide emission reductions of 70 to 90 percent, and (4) combustion durability and flexibility. Coal ash retention of 90 to 95

percent in the combustor is an advantage because it can reduce boiler maintenance due to slagging and fouling and can reduce particulate matter removal costs.

A coal combustor can be generically defined as a device mounted on a boiler or heater in which coal and oxygen are combined and combusted to produce usable heat. Combustors in varying sizes and configurations have been used by the industrial and utility sectors for years. However, the full realization of their performance potential has been limited by environmental constraints, such as the New Source Performance Standards (NSPS). The high operating temperatures necessary for substantial improvements in thermal efficiency have invariably resulted in the production of unacceptable levels of NOx, while their use with high sulfur coals has produced unacceptable levels of sulfur dioxide (SO2).

An advanced combustor, however, is a device that can control or remove objectionable sulfur and particulate matter from coal-derived fuel before it is injected into retrofitted oil or gas boilers or heaters, and can control the formation of NOx by controlling combustion temperature characteristics. Although these combustors are primarily intended for retrofit applications, they will also be applicable and appropriate for incorporation into the design of new facilities that utilize their compact size and flexibility of coal use.

Advantages of the technology proposed by Coal Tech Corporation include that it can be adapted to retrofit boilers or can be used in new installations. It has industrial and utility applications and can be used for converting oil and gas designed boilers to coal, or for the repowering of existing coal fired boilers. The technology also has the advantage of being suitable for installation in modules, which allows gradual increases of capacity and capital expenditures. These features are especially important to utilities because they allow phased or staged capacity increases as required by demand and reduces economic risks. Coal Tech's advanced slagging combustor controls particulates by converting the ash into molten slag and providing for its removal prior to entry into the boiler. The formation of oxides of nitrogen is controlled to levels at least as stringent as NSPS by staged combustion to suppress temperatures. Sulfur dioxide is reduced (from 70% to 90%) by the injection of alkali compounds during combustion to capture the sulfur as a component part of the slag.

Economic advantages of this technology include the potential for lower capital cost conversion. The technology appears to be competitive with LIMB retrofit technologies for existing coal-fired power plants.

The potential market for this technology is expressed in terms of the number of combustors in the U.S. that could be converted. It is estimated that from 20,000 to 35,000 combustors in the U.S. could be the potential market for this technology.

2.1.1.2 Pressurized Fluidized-Bed Combustion

The American Electric Power Service Corporation project, titled "Tidd Pressurized Fluidized-Bed Combustion (PFBC) Demonstration Plant," is to construct and operate a 70 MWe PFBC Combined Cycle Demonstration Plant in Brillant, Ohio. The combined cycle plant will operate at a combustion temperature of 1580 degrees Fahrenheit and a pressure of 12 atmospheres. The combustion gases are to be expanded through an ASEA STAL GT-35P gas turbine with a steam turbine bottoming cycle. The demonstration plant will be retrofitted into a mothballed coal-fired power plant and will utilize existing utilities (e.g., coal conveyors, electrical and water systems).

PFBC technology involves burning coal in a bed containing limestone (calcium carbonate) or dolomite (calcium magnesium carbonate) inside a furnace operated at elevated pressure. The bed material (coal/sorbent/inert material) is fluidized through the injection of air at the bottom of the bed. Sulfur dioxide released during the combustion of coal reacts with the sorbent and forms a sulfate that can be discharged from the system as a dry solid waste.

Advantages of the technology proposed by American Electric Power include the fact that it can be integrated with a steam-cooled, combined-cycle facility. The PFB combustor can fire run-of-mine coal, and energy can be recovered through steam extraction, which can generate electric power via steam turbines. The PFB combustion gases are expanded through a gas turbine for the generation of additional electric power. The SO2 and NOx emissions are controlled in-situ through sorbent injection and low-temperature combustion operating conditions, respectively. The particulate matter is controlled upstream of the gas turbine with high efficiency cyclones and downstream with a conventional electrostatic precipitator or a fabric filter. Emission data based on numerous operating hours at several facilities, including the 15 MW Component Test Facility, which has completed over 4,500 hours of operation, show that such technology would meet or exceed the NOx and SOx emission requirements of the existing and proposed NSPS. Compared to a conventional coal-fired power plant using 3.4 percent sulfur-content coal, it has been estimated that this technology would enable a 15 percent reduction in SO2 and a 57 percent reduction in NOx above and beyond New Source Performance Standards.

The technology can be used for new facilities (i.e., grass roots projects) or for repowering of existing coal plants to reduce emissions while increasing plant capacity and extending plant life. Repowering is increasingly being used by U.S. utilities as an option for increased capacity because of its favorable life-cycle economics. It can be built in modular increments of 80 MW or 320 MW which offers a number of important advantages. These advantages include lower investment risk and the use of faster and less expensive fabrication methods. This system will result

in thermal efficiencies in excess of 40% as compared with pulverized coal boilers with scrubbers, which have maximum thermal efficiencies of about 36%.

Estimates are that both capital and busbar costs for commercial applications of this technology would be 9 percent less than conventional pulverized coal fired plants with flue gas desulfurization. The potential market for this technology, which is applicable to the utility sector, is estimated to be 60,000 to 112,000 MWe.

2.1.1.3 Flue Gas Cleanup

Two projects selected for the CCT Program will demonstrate flue gas cleanup technology. They are the Babcock & Wilcox Company project titled "LIMB Demonstration Project Extension" and the Energy & Environmental Research Corporation project titled "Gas Reburning/Sorbent Injection."

2.1.1.3.1 The Babcock & Wilcox Project

The Babcock & Wilcox project is for development of retrofit acid rain precursor control technologies. The first part of the project is an extension of an ongoing Limestone Injection Multistage Burner (LIMB) testing program. Babcock & Wilcox is currently conducting the full-scale demonstration of the LIMB technology on a 105 MWe wall-fired utility boiler in a project cosponsored by the U.S. Environmental Protection Agency (EPA) and the State of Ohio. The objectives of the current test are to demonstrate NOx and SO2 emissions reductions on the order of 50-60 percent at a capital cost at least $100 per kw less than wet SO2 scrubbers. As a result of funding limitations of the existing contract, testing will be restricted to one sorbent and one coal in this EPA sponsored test. An advantage offered by the DOE's proposed CCT project will be to broaden the applicability of the LIMB technology by extending the numbers and types of coals and sorbents to be evaluated.

An economic advantage associated with commercialization of this retrofit technology involves low capital cost in comparison with competing technologies. For example, LIMB has been estimated to require about half the capital cost of wet SO2 scrubbers.

The second part of the Babcock & Wilcox project is to evaluate the Conoco "Coolside" process for SO2 control. This process involves dry sorbent injection/humidification technology downstream of the boiler. The proposed demonstration will provide a side-by-side comparison with LIMB technology. Again, the immediate application would be for low-cost retrofit to existing boilers. With this system there is no need for expensive injectors, which is an advantage realized in process economics. The "Coolside" process is largely boiler independent, since it does not involve in-furnace sorbent injection. This may be particularly beneficial for high-sulfur coals, for which the necessary level of in-furnace sorbent injection could cause some

degradation of boiler performance. Overall the process requires minimal hardware and has a low capital cost. An SO2 reduction of 75% is anticipated using this technology with 3% sulfur coal, when compared to conventional coal-fired boilers.

2.1.1.3.2 The Energy & Environmental Research Corp. Project

The Energy and Environmental Research Corporation in conjunction with the Gas Research Institute and the State of Illinois proposes to demonstrate a combination of gas reburning and sorbent injection for the control of sulfur dioxide and nitrogen oxide emissions from existing coal-fired boilers. Reburning is achieved by injection of natural gas (10 to 20 percent of the total fuel input) above the normal furnace heat release zone to produce an oxygen deficient region in the upper furnace (reburning zone). Burnout air is introduced above the reburning zone to complete the fuel combustion. An advantage of the process is that a portion of the NOx produced in the main heat release zone is decomposed to molecular nitrogen in the reburning zone. A further advantage results from the fact that the reburning fuel contains no sulfur, and therefore sulfur dioxide emissions are reduced in proportion to the amount of natural gas fired. Additional reduction of sulfur dioxide emissions are obtained by injection of calcium based sorbents either with the burnout air or downstream between the air preheater and the electrostatic precipitator. This retrofit project proposes to demonstrate a combination of gas reburning and sorbent injection, with program goals of 60 percent reduction of oxides of nitrogen and 50 percent reduction of sulfur dioxide emissions.

Economic advantages of commercial applications of the Energy and Environmental Research Corporation's technology would result from low capital cost requirements. These have been projected to be three to six times less than the cost of competing commercial processes.

Both B&W and EER projects involving flue gas cleanup, are estimated to have a potential electric utility market of 79,000 - 130,000 MWe.

2.1.1.4 Surface Coal Gasification

There are two CCT projects selected which will involve surface coal gasification. The M.W. Kellogg project titled "The Appalachian Project" and the General Electric Company project titled "Integrated Gasification - Steam Injection Gas Turbine."

2.1.1.4.1 The M.W. Kellogg Project

The M.W. Kellogg project will demonstrate an advanced integrated coal gasification combined cycle system. The project will feature the "KRW" Ash Agglomerating Fluidized-bed Gasification Process using in-bed desulfurization with advanced "hot gas cleanup" for particulate and sulfur control, and a General Electric MS 6001 gas turbine combined cycle power system.

A major advantage of the technology is that it will feature a hot gas cleanup system which delivers fuel gas at 1000F - 1200F to the combustion turbine, thus avoiding costly inefficient low temperature cleanup processes. This results in capital costs estimated to be as low as $1000 per kilowatt. This is made possible by the use of in-bed desulfurization and a hot-sulfur-removal polishing step which uses a zinc ferrite sorbent bed. Particulates will be removed by the use of a sintered metal filter. The system, once it has been demonstrated, will be highly efficient with heat efficiency rates around 7,800 Btu/kWhr (compared with a conventional coal-fired steam plant which has heat rates of around 10,000 Btu/kWhr). Sulfur dioxide is anticipated to be reduced by 96% and NOx reduced by 50% over current utility NSPS. The technology also has the advantage of being appropriate for installation in a modular manner. The ability to use modules is an important advantage to utilities because it allows phased or staged construction of power units one by one as increased demand requires. Phased construction allows gradual increases in capacity and capital expenditures. Also a very short time is required from start of construction to initial generation of electricity resulting in lower economic risks.

This technology has the potential to be used both for retrofit or repowering of existing units, and for new sources of power. Repowering refers to the integration of a new combustion turbine power generation unit with an existing utility steam boiler to create a combined cycle system. An advantage of this concept is that the thermal efficiency of a combined cycle is significantly better than that for a steam cycle.

2.1.1.4.2 The General Electric Co. Project

The General Electric Company project will use an integrated coal gasification, steam-injected gas turbine power plant to demonstrate the feasibility of simplified gasification systems for commercial coal-to-electricity applications. An advantage of the simplified system is that it is configured to reduce components in each of the major subsystems thus improving the economics of the power producing system. The technology uses an air-blown moving bed gasifier, zinc-ferrite sulfur removal technology, hot cyclones, and the "LM" series (aircraft derivative) gas turbine/generator package. Key elements are the high-temperature gas cleanup systems which can produce significant reductions in the contaminant levels without degradation of plant efficiency. The thermal efficiency for this system will be 36% for the demonstration facility and 42% for a commercial-scale facility, with anticipated turbine improvements.

The commercialization of this technology for new sources of power could lead to significantly reduced emissions of sulfur dioxide and nitrogen oxides as compared with current utility NSPS. It is anticipated that sulfur dioxide can be reduced by 75% and NOx reduced by 19% over current utility NSPS.

Commercial versions of this General Electric technology have been estimated to have 10% - 15% less capital costs than conventional pulverized coal fired plants with flue gas desulfurization. A 10% - 15% lower cost per kilowatt of electricity has also been estimated.

The potential market estimates provided in this case are 200,000 to 5,000,000 Btu per year.

2.1.1.5 In-Situ Gasification

The Energy International project titled "UCG/Clean Fuels Proof-of-Concept Project" is a demonstration of steeply dipping bed underground coal gasification technology applied to the sub-bituminous coal deposits of Wyoming.

An advantage of in-situ gasification technology is that it allows coal to be recovered from otherwise unrecoverable deposits through underground gasification of coal. The medium-Btu product gas containing tars, particulates, and sulfur and nitrogen compounds is transported to the surface, where state-of-the-art gas cleaning methods are used to produce a feed gas for indirect liquefaction in which clean liquid products and synthetic natural gas are produced. These fuels have broad market applications. The project will convert 200 tons/day of coal to clean liquids and gases while sulfur dioxide emissions from the demonstration facility are expected to be only about 760 pounds per day. The sulfur and nitrogen content of the fuels produced should be similar to those of refined oil and in the case of the gas produced, natural gas. Economic advantages expected from the technology include beneficial socioeconomic impacts resulting from increased employment.

A potential market in excess of 100,000,000 tons of coal per year has been estimated.

2.1.1.6 Liquefaction

The project sponsored by Ohio Ontario Clean Fuels Inc. is titled "Prototype Coal-Petroleum Coprocessing Plant." The process to be utilized in the project is Coal/Oil Co-Processing, employing proprietary ebullated-bed reactor technology of Hydrocarbon Research, Incorporated. In this process, clean liquid fuels are produced from coal, petroleum residuum, and natural gas. Coal is blended with residual oil in the process and both are simultaneously converted to clean distillate fuels.

An advantage of the process is that it produces a "typical" distillate fuel that will contain 0.1 percent sulfur and 0.2 percent nitrogen. Coprocessing will produce premium liquids which when burned will be within the stringent SO2, NOx and particulate environmental standards that apply to the combustion of liquid fuels.

Commercial applications of this technology have the potential to reduce the cost of liquid products from direct liquefaction by 50 percent. The potential market is estimated at 230,000 barrels per day of clean distillate liquid.

2.1.1.7 Industrial Processes

The project sponsored by the Weirton Steel Corporation titled "Kohle Reduction (KR) Ironmaking Demonstration Plant" is an industrial process. The Weirton Steel project will demonstrate an innovative technology for industrial coal use that will be more efficient and environmentally safe than available technology.

The Weirton Steel project will utilize the KR process, developed by Korf Engineering (a West German Company), to replace the two-step coke oven/blast furnace approach to producing pig iron from iron ore and metallurgical coal with an integrated two component oxygen-blown blast furnace system capable of operation on a variety of U.S. coals. The system consists of an upper "reduction shaft" and a lower "melter-gasifier" component. Iron ore, along with an appropriate flux (e.g., limestone), is fed into the top of the reduction shaft where it is reduced to sponge iron by the off-gas from the lower melter-gasifier section. The lower section is an oxygen-blown fluidized-bed coal gasifier. In this section the sponge iron is melted and the resulting pig iron and slag are separated and tapped as in a blast furnace. The low/medium-Btu, sulfur-free off-gas from the process (sulfur is captured by limestone and remains in the slag) is scrubbed to remove particulates and is available for site use.

There are a number of advantages that this process offers. These include the ability to use a wide range of coals thus reducing the need to use the more expensive coking coals now required in the steel making process, eliminating the need for coke minimizing or eliminating the pollutants generated during the production of coke, and significantly reducing the air emissions normally associated with iron making by the coke plant - blast furnace route. These reductions include about 94% of the particulates and about 60% of the SO2. From an environmental point-of-view, the "KR" process is a particularly attractive substitute for the currently used steel making process. The technology also has the advantage of being appropriate for installation in modules, thereby allowing relatively small incremental increases in capacity not possible with conventional coke oven - blast furnace technology.

The technology has an estimated economic advantage of $30.00 per ton of hot metal (THM) lower cost than that produced in a conventional coke plant/blast furnace operation (i.e., an estimated $202/THM versus $172/THM for a 2,712 ton per day plant). The Weirton Steel project is estimated to have a potential market of from 30 to 60 million tons of iron per year.

2.1.2 Commercial Availability of Selected Projects

When the nine projects selected under the CCT Program will be commercially deployed is purely conjecture at this time. However, the steps the projects must go through to become commercial are briefly outlined in the following discussion.

Table 3 contains a list showing the proposed duration of the nine projects selected for award under the CCT PON. Project duration provides an indication of how long it will take to complete each demonstration project (from the time cooperative agreements are signed). The demonstration should provide the technical, economic, environmental and other information needed to plan, construct and operate the commercial versions of these technologies.

The CCT projects will not be commercial until their demonstrations are completed and commercial size projects are subsequently constructed and operated by the private sector. The process of completing the demonstration, designing a commercial size plant, obtaining necessary permits, constructing and successfully completing shakedown on a commercial scale, could take years to complete.

Table 3

Estimated Durations of the Nine Projects

Selected for Award Under the Clean Coal Technology

Program Opportunity Notice

Projects	Project Duration*
1. American Electric Power Service Corporation	76 months
2. Babcock & Wilcox	43 months
3. Coal Tech Corporation	27 months
4. Energy & Environmental Research Corporation	48 months
5. Energy International, Inc.	36 months
6. General Electric Company	60 months
7. Ohio Ontario Clean Fuels, Inc.	52 months
8. The M.W. Kellogg Company	63 months
9. Weirton Steel Corporation	55 months

* from date of execution of the Cooperative Agreement

2.2 Comparison of Selected Clean Coal Technology Projects to the Special Envoys Recommendations

2.2.1 Key Factors in the Special Envoys Report

The historical development of the CCT Program differs from that of the Special Envoys' Report. However, Table 4 shows that many of the projects selected under the CCT Program have the potential for resulting in applications that will meet most of the objectives of the Special Envoys' recommendations.

Applications

Because of their average sizes, electric-generating utility boilers are the largest sources of pollutant emissions, including emissions of suspected acid deposition precursors. Eight of the nine selected projects for the CCT Program are for utility applications. Several of these, such as the General Electric and Coal Tech projects, can also be used for industrial applications. The Energy International, Inc. in-situ gasification project and the Ohio Ontario coal coprocessing project will produce clean fuels from coal which could be used by utilities or any other energy market sector. Only the Weirton Steel project is not intended for utility applications.

Emissions Reduction

As can be seen in Table 5, all nine selected projects have the potential to reduce emissions of SO2 and NOx. (It should be noted that the Energy International underground coal gasification and the Ohio Ontario coal-oil coprocessing technologies should produce clean fuels from coal that should mimic refined petroleum products for a variety of applications). The column labeled "Improvement Over Uncontrolled Units" in Table 5 refers to retrofit applications, whereas the column labeled "Improvement Over NSPS" refers to new facility applications.

In general, and based upon data derived from the CCT proposals and the offerors themselves, the selected technologies in their commercial applications as new, "grass roots" projects, have the potential for emissions reductions of 15 to 96 percent for SO2 and 19 to 67 percent for NOx over current utility New Source Performance Standards (and a conventional coke oven/blast furnace for the Weirton proposal). Those technologies which can be used for retrofit applications have the potential for reductions of 50 to over 99 percent for SO2 and 50 to 80 percent for NOx as compared with a coal-fired power plant presently uncontrolled and using a 3.4% sulfur coal.

Five of the nine demonstration projects are expected to result in reduced emissions at the demonstration plant sites. The American Electric Power Service project would have much lower emissions than the currently mothballed, uncontrolled coal-fired power plant it will replace when it is operating. The Babcock and Wilcox and Energy and Environmental Research technologies

TABLE 4

COMPARISON OF CCT PROJECTS TO SPECIAL ENVOYS RECOMMENDATIONS

OFFEROR NAME:	ABBREVIATED TITLE	RECOMMENDATION 1			PARTIAL RECOMMENDATION 2	PARTIAL RECOMMENDATION 3	RECOMMENDATION 4
		APPLICABLE TO UTILITIES	EMISSION REDUCTION		ECONOMIC IMPROVEMENTS	APPLICABLE TO RETROFIT	USE HIGH SULFUR COAL
			DEMO	COMMERCIAL			
AMERICAN ELECTRIC POWER SERV.	TIDD PFBC DEMO PLANT	Y	Y	Y	Y	Y	Y
THE BABCOCK & WILCOX COMPANY	LIMB DEMO PROJECT EXTENSION	Y	Y	Y	Y	Y	Y
COAL TECH CORPORATION	ADVANCED CYCLONE COMBUSTOR DEMO	Y	N	Y	Y	Y	Y
ENERGY & ENVIRONMENTAL RESEARCH	GAS REBURNING/SORBENT INJECTION	Y	Y	Y	Y	Y	Y
ENERGY INTERNATIONAL, INC.	UCG/CLEAN FUELS PROOF-OF-CONCEPT PROJECT	Y	N	Y	Y	N	N
GENERAL ELECTRIC COMPANY	INTEGRATED GASIFICATION-STEAM INJECTION GAS TURBINE	Y	Y	Y	Y	N	Y
THE M.W. KELLOGG COMPANY	THE APPALACHIAN PROJECT	Y	N	Y	Y	Y	Y
OHIO ONTARIO CLEAN FUELS INC.	COAL-PETROLEUM COPROCESSING PLANT	Y	N	Y	Y	N	Y
WEIRTON STEEL CORPORATION	KR IRONMAKING DEMO PLANT	N	Y	Y	Y	N	Y

Notes:
- Recommendations listed on page ii and iii.
- Recommendation 3 also relates to location of the demonstration; a map of demonstration project locations is provided in Figure 1.
- Recommendation 2 cannot be directly addressed by publicly available data.
- Y indicates yes; N indicates no.

TABLE 5

ESTIMATED IMPROVEMENTS IN EMISSIONS CONTROLS OVER CURRENT REQUIREMENTS

OFFEROR NAME:	ABBREVIATED TITLE	COMMERCIAL FACILITY SIZE	ESTIMATED PERCENT IMPROVEMENT OVER CURRENT REQUIREMENTS (1)			
			IMPROVEMENT OVER UNCONTROLLED UNITS (2)		IMPROVEMENT OVER NSPS (3)	
			SO2	NOx	SO2	NOx
AMERICAN ELECTRIC POWER SERV.	TIDD PFBC DEMO PLANT (4)	80 MW	93	73	15	57
THE BABCOCK & WILCOX COMPANY	LIMB DEMO PROJECT EXTENSION (4)(7)					
	- LIMB	300 MW	55	55	-	-
	- "COOLSIDE"	300 MW	80	50	-	-
COAL TECH CORPORATION	ADVANCED CYCLONE COMBUSTOR DEMO (4)	150 MW	90	80	05	67
ENERGY & ENVIRONMENTAL RESEARCH	GAS REBURNING/SORBENT INJECTION (4)(7)	300 MW	50	60	-	-
ENERGY INTERNATIONAL, INC.	UCG/CLEAN FUELS PROOF-OF-CONCEPT PROJECT (8)	5400 TONS/DAY	-	-	-	-
GENERAL ELECTRIC COMPANY	INTEGRATED GASIFICATION-STEAM INJECTION GAS TURBINE (4)	80 MW	-	-	75	19
THE M.W. KELLOGG COMPANY	THE APPALACHIAN PROJECT (4)	80 MW	99+	69	96	50
OHIO ONTARIO CLEAN FUELS INC.	COAL-PETROLEUM COPROCESSING PLANT (8)	21,000 BPD	-	-	-	-
WEIRTON STEEL CORPORATION	KR IRONMAKING DEMO PLANT (5)(6)	1 MM TONS/YR	-	-	59	NA

NOTES:

(1) Potential performance capability.
(2) Emission reductions over uncontrolled based on emission factor of 18 Lb NOx/ton of coal fired and a heat rate of 12,000 Btu/kw-hr.
(3) Emission reductions over NSPS based on 90% SO2 removal or 0.6 Lb SO2/MMBtu, 0.6 Lb NOx/MMBtu, and a heat rate of 10,000 Btu/kw-hr.
(4) Percent improvement estimates based on firing coal with a sulfur content of 3.4% and a heating value of 11,240 Btu/Lb.
(5) Weirton emission reductions based on a comparison with emissions from production of 1,000,000 tons of hot metal per year from coke oven/blast furnace operations.
(6) NOx emissions from coke oven/blast furnace not available (NA).
(7) Technology applicable only to retrofit applications.
(8) Fuel-producing technology, therefore percent reduction of emissions not applicable.

likewise would result in emissions reductions since they are to be retrofitted to existing coal-fired power plants for pollution control purposes. That portion of the General Electric project which is to be located at Niagara Mohawk could reduce emissions there by generating replacement electricity cleaner than can be currently produced. The Korf process to be used by Weirton Steel in their demonstration project will replace Weirton's current coke oven and blast furnace operations thereby considerably reducing emissions during the demonstration period.

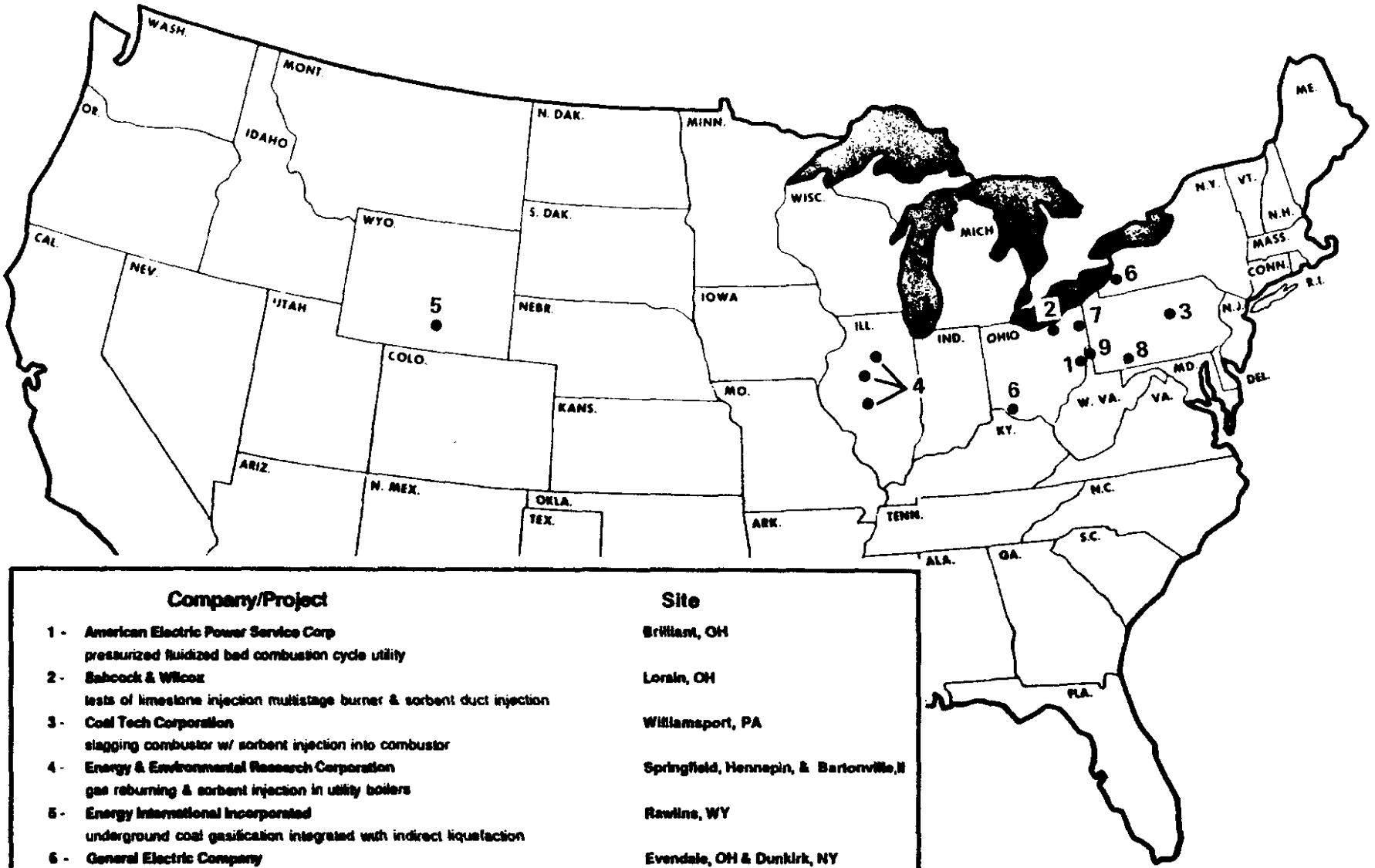
In addition, most of the selected projects are located in a region of the United States which is relevant with respect to environmental concerns related to transboundary air pollution with Canada. Science has not advanced enough to determine quantitatively the source/receptor relationships which apply to acid deposition. However, one significant factor appears to be that the closer a source in the U.S. is located to Canada, the more influence it has on transboundary acid deposition. The geographic distribution of CCT projects is shown in Figure 1. Eight of the nine projects selected are located in Illinois, New York, Ohio, Pennsylvania and West Virginia. These sites are relatively close to the U.S. - Canadian border in a region of particular interest with respect to transboundary air pollution. This was not a factor in the evaluation of proposed projects under the CCT Program.

Economic Improvements

As discussed in Section 2.1.1, and as summarized in Table 4, economic improvements are anticipated from all the selected CCT technologies. A recommendation of the Special Envoys was that among projects with similar potential, government funding should go to those that reduce emissions at the least cost per ton. Costs for emission reductions for the CCT projects on a cost per ton basis are not available at this time for inclusion in this report.

Retrofit Applications

The Special Envoys' report specifies applicability to "existing sources." The usual interpretation of "sources" in NSPS and elsewhere is to mean a whole plant or facility. Five of the nine projects selected can be retrofitted to existing sources. Two of the projects will produce clean fuels from coal that could displace oil and/or natural gas or could be used with new burners in existing coal-fired facilities. The remaining two projects will result in very clean technologies for new applications that should help in the long term reduction of SO2 and NOx by replacing older, inefficient, and mostly uncontrolled facilities with these technologies. (Refer to Section 2.2.2 for a discussion of "grass roots" applications.)



	Company/Project	Site
1 -	**American Electric Power Service Corp** pressurized fluidized bed combustion cycle utility	Brilliant, OH
2 -	**Babcock & Wilcox** tests of limestone injection multistage burner & sorbent duct injection	Lorain, OH
3 -	**Coal Tech Corporation** slagging combustor w/ sorbent injection into combustor	Williamsport, PA
4 -	**Energy & Environmental Research Corporation** gas reburning & sorbent injection in utility boilers	Springfield, Hennepin, & Bartonville,Il
5 -	**Energy International Incorporated** underground coal gasification integrated with indirect liquefaction	Rawlins, WY
6 -	**General Electric Company** integrated coal gasification steam injection gas turbine with hot gas cleanup	Evendale, OH & Dunkirk, NY
7 -	**Ohio Ontario Clean Fuels Inc.** coal-oil co-processing liquefaction	Warren, OH
8 -	**The M.W. Kellogg Company** fluidized bed gasification w/ hot gas cleanup integrated combined cycle	Cairnbrook, PA
9 -	**Weirton Steel Corporation** direct iron ore reduction to replace coke overvblast furnace	Weirton, WV

FIGURE 1

CLEAN COAL TECHNOLOGY PROJECTS

The Babcock and Wilcox technologies, LIMB and "Coolside" injection of an SO2 sorbent, are intended to be used, among other things, for the retrofit of existing coal-fired facilities to reduce SO2, and in the case of LIMB, NOx as well. The demonstration project will employ these technologies by retrofitting an existing coal-fired boiler.

The Energy and Environmental Research Corp. technology, gas reburning and sorbent injection, also is intended for use for the retrofit of existing combustion sources to reduce SO2 and NOx emissions, among other things. The demonstration will show the retrofit potential on three different types of coal-fired boilers.

The Coal Tech Corp. technology, an advanced slagging combustor with sorbent injection, can be used in both grass roots or retrofit applications. Although primarily a technology to retrofit existing oil or gas fired units with coal, as proposed in the demonstration, it has the definite capability to be used as a retrofit to existing coal-fired boilers for capacity enhancement and pollution control.

The American Electric Power Corp. technology, pressurized fluidized-bed combined cycle, can both be used in grass roots operation as well as for retrofit/repowering applications as is proposed in the demonstration. If used for repowering of existing sources, the technology has the potential for reducing SO2 and NOx emissions, while at the same time increasing generating capacity and extending plant life.

The M.W. Kellogg Co. technology, integrated gasification combined cycle, also can be used in both grass roots and retrofit/repowering applications. If used as a retrofit/repowering technology to existing coal-fired boilers, it could increase electricity output, extend plant life and reduce pollutant emissions significantly.

Four of the proposed CCT technologies will likely not be considered for retrofit applications. The technology proposed by Weirton, the production of pig iron in an advanced coal process, is one of these. The technology is expected, however, to greatly reduce the emissions associated with the coke oven and blast furnaces of the conventional iron-making technologies with which it is expected to compete. The General Electric technology, integrated gasification steam injected gas turbine, also is not likely to be used for retrofit/repowering applications because it does not utilize a bottoming cycle.

The technologies proposed by Energy International, Inc. and Ohio Ontario Clean Fuels, Inc., in-situ gasification of steeply dipping coal bed seams and coal-petroleum coprocessing, respectively, are not retrofit technologies although they will produce fuels from coal that should be as clean as petroleum based products.

Use of High Sulfur Coal

All but one of the nine projects selected have either proposed that their demonstration projects, or the commercial versions of their projects will utilize high sulfur coals. Only the Energy International, Inc. project to gasify, in situ, the steeply dipping coal seams located primarily in the low sulfur coal fields in the West, does not utilize high sulfur coals.

2.2.2 "Grass Roots" Applications -- Emission Control Implications

Several of the projects selected under the CCT Program are also anticipated to be used commercially in new, "grass roots" facilities. The projects proposed by the General Electric Company, the M.W. Kellogg Company, the American Electric Power Service Corporation and the Weirton Steel Corporation, all can be used for new electricity and/or industrial markets.

These advanced "grass roots" technologies have significant implications from an emissions control perspective. As has been shown in many analyses conducted by industry and the government, SO2 emissions are anticipated to significantly decline over time as old, poorly controlled coal-fired power plants are replaced by new plants meeting NSPS even with the large increases in coal utilization that are expected to occur. The projections in Figures 2 and 3 are based on information in the report "An Economic Assessment of Long Term Emissions Reduction Alternatives," May 1985, by ICF, Inc. Figure 2 shows the SO2 reduction implications of NSPS over time as a function of utility boiler retirement age. Projected utility SO2 emissions assuming a 60 year power plant life are shown compared to a more typical assumption of 45 years life (assuming constant NSPS in both cases). As shown in Figure 3, clean coal technologies such as those selected in the CCT Program, once commercialized, have the potential to accelerate the decline in SO2 emissions as a result of their ability to control SO2 better and/or more economically than with conventional technologies. The economic advantages, particularly under conditions of more stringent environmental regulations, should result in accelerated replacement of older plants. In Figure 3, "current technology" estimates were based on an assumption of constant NSPS requirements. It was assumed for "new technology" estimates in Figure 3 that current NSPS requirements would apply until the year 2000. From the year 2000 until the year 2010, an upgraded NSPS requirement of 0.4 lb SO2/MMBtu maximum emission limit and 95% SO2 reduction was assumed. After the year 2010, a further NSPS upgrade to 0.2 lb SO2/MMBtu maximum emission limit and 97.5% SO2 reduction was assumed.

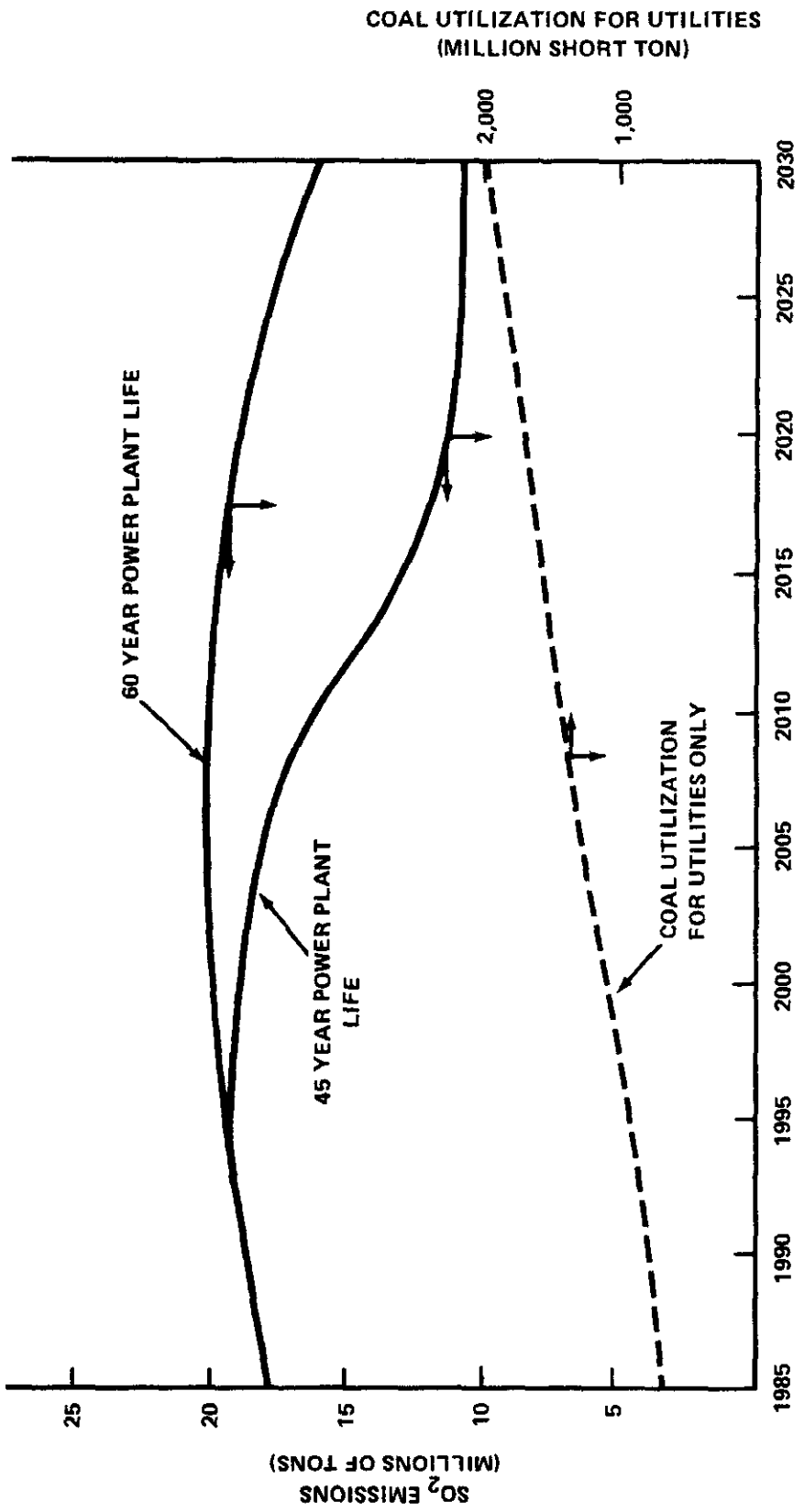


FIGURE 2
EFFECT OF POWER PLANT LIFE
ON PROJECTED UTILITY SO_2 EMISSIONS

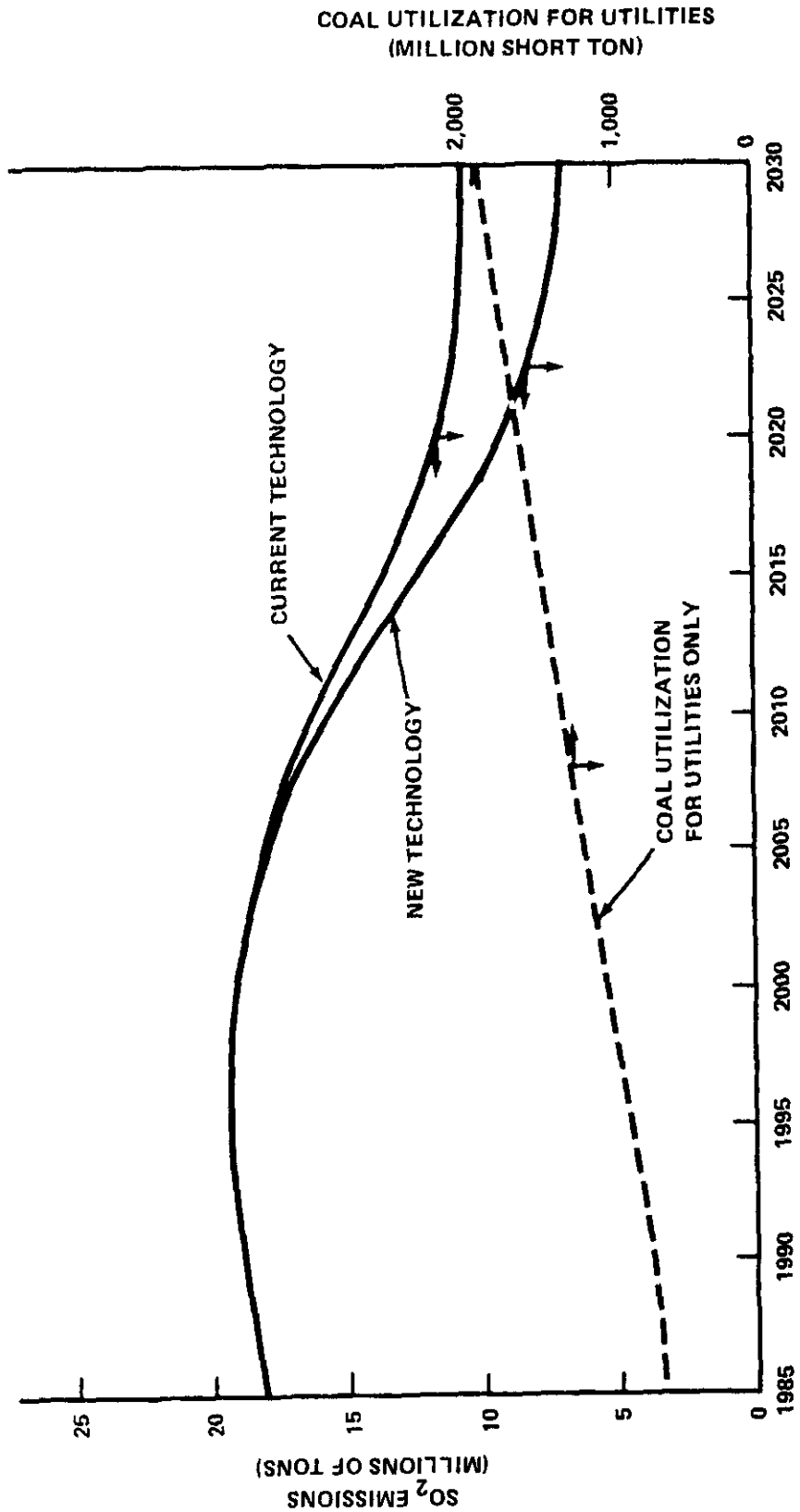


FIGURE 3
POTENTIAL IMPACT OF NEW TECHNOLOGY
ON PROJECTED UTILITY SO_2 EMISSIONS
(45 YEAR POWER PLANT LIFE ASSUMED)

Figures 2 and 3 are also based on the following additional assumptions:

Year	Electricity Growth Rate (%/Yr)	Real GNP (%/Yr)	Nuclear (1) Capacity Factor (%)	Nuclear (1) Capacity (GW)
1983-1985	4.0	4.0	60	72
1986-1990	2.6	3.0	64	106
1991-1995	2.3	2.5	67	109
1996-2000	2.3	2.3	67	113
2000-2010	2.1	2.1	67	170
2010-2020	1.8	1.8	67	210
2020-2030	1.5	1.5	67	260

Note (1) - "at end of interval"

Figure 3 does not account for changes in the retirement schedules for old plants due to improved economics of new technologies or due to effects of different environmental regulations.

Many of the clean coal technologies selected have the added advantages of improved NOx performance and production of useable or more easily disposable wastes than conventional technologies.

The longer term strategy for SO2 control, that of replacement of old plants which are retired, has several advantages over requirements which would result in the immediate installation of SO2 controls at existing plants. These include:

- o the reduction of present value utility costs by phasing these emission reductions gradually over time.
- o the prevention of regional coal production impacts by ensuring that major emissions reductions and, thus, coal switching would occur after high sulfur coal production has grown significantly above current levels.
- o Defray control costs by giving utilities greater flexibility in meeting emission limits imposed on individual power plants or units (e.g., trading emission rights between existing and new utility power plants).

Thus, this strategy should also be considered along with the retrofit strategy in the acid deposition deliberations.

APPENDIX A

PROJECT DESCRIPTIONS OF THE NINE SELECTED CLEAN COAL TECHNOLOGY PROJECTS

OFFEROR NAME	ABBREVIATED TITLE
AMERICAN ELECTRIC POWER SERVICE CORPORATION	TIDD PFBC DEMONSTRATION
BABCOCK & WILCOX COMPANY, THE	LIMB DEMONSTRATION PROJECT EXTENSION
COAL TECH CORPORATION	ADVANCED CYCLONE COMBUSTOR DEMONSTRATION
ENERGY & ENVIRONMENTAL RESEARCH CORPORATION	GAS REBURNING/SORBENT INJECTION
ENERGY INTERNATIONAL, INC.	UCG/CLEAN FUELS PROOF-OF-CONCEPT PROJECT
GENERAL ELECTRIC COMPANY	INTEGRATED GASIFICATION-STEAM INJECTED GAS TURBINE
M.W. KELLOGG COMPANY	THE APPALACHIAN PROJECT
OHIO ONTARIO CLEAN FUELS INC.	COAL-PETROLEUM COPROCESSING PLANT
WEIRTON STEEL CORPORATION	KR IRONMAKING DEMO PLANT

PROJECT SUMMARY

PROPOSER:	American Electric Power Service Corporation
PROJECT TITLE:	TIDD PFBC Demonstration Plant
PROJECT LOCATION:	Brilliant Ohio -- Jefferson County
TECHNOLOGY:	Pressurized Fluidized-Bed Boiler
APPLICATION:	Electric Utility (New/Retrofit)
PRODUCT:	Electricity
TYPE OF COAL USED:	Ohio High Sulfur Bituminous
PROJECT SIZE:	70 MWe
PROJECT STARTING DATE:	04/30/86
PROJECT DURATION:	76 months
COST SHARING:	Average Participant Share - 66% Average DOE Share - 34%
PROPOSED CO-FUNDERS:	American Electric Power Service Corporation State of Ohio

PROJECT DESCRIPTION:

The American Electric Power Service Corporation (AEPSC), on behalf of the Ohio Power Company, proposes to construct and operate a 70 MWe Pressurized Fluidized-Bed Combustion (PFBC) Combined Cycle Demonstration Plant in Brilliant, Ohio, located on the Ohio River approximately 76 miles downstream from Pittsburgh, Pennsylvania. The project will utilize technology developed by ASEA-PFB and marketed in the U.S. by ASEA Babcock PFBC (a joint venture between ASEA and Babcock & Wilcox). The combined cycle plant will operate at 1,580^{o}F and a pressure of 12 atmospheres with off-gases expanding through a ASEA STAL GT120 gas turbine with a steam turbine bottoming cycle. The demonstration plant will be retrofitted into a moth-balled coal-fired power plant and will utilize the existing steam turbine and other site utilities.

PROJECT SUMMARY

PROPOSER:	The Babcock & Wilcox Company
PROJECT TITLE:	LIMB Demonstration Project Extension
PROJECT LOCATION:	Lorain, Ohio -- Lorain County
TECHNOLOGY:	Flue Gas Cleanup - LIMB and "Coolside" duct injection of sorbent
APPLICATION:	Utility
PRODUCT:	Environmental Control Technology
TYPE OF COAL USED:	Medium to high sulfur coal.
PROJECT SIZE:	105 MWe
PROJECT STARTING DATE:	09/01/86
PROJECT DURATION:	43 months
COST SHARING:	Average Participant Share - 61% Average DOE Share - 39%
PROPOSED CO-FUNDERS:	Babcock & Wilcox Company Conoco Inc. State of Ohio Dravo

PROJECT DESCRIPTION:

A two part project is proposed by Babcock & Wilcox for development of retrofit acid rain precursor control technologies. The first part is an extension of ongoing Limestone Injection Multistage Burner (LIMB) testing. Babcock & Wilcox is currently conducting the full-scale demonstration of the LIMB technology on a 105-MWe wall-fired utility boiler in a project cosponsored by the U.S. Environmental Protection Agency and the State of Ohio at Ohio Edison's Edgewater Station in Lorain, Ohio. The objectives of this project are to demonstrate NO_x and SO_2 emissions reductions on the order of 50-60 percent at a capital cost at least $100 per kW less than wet scrubbers. As a result of funding limitations of the existing contract, testing will be restricted to one sorbent and one coal. The results of the project proposed here will broaden the applicability of the LIMB technology by extending the number and types and sorbents to be evaluated.

The second part of the project is to evaluate the Conoco "Coolside" process for SO_2 control. This process involves dry sorbent injection/humidification technology downstream of the boiler. The "Coolside" technology has been tested by Conoco in the laboratory and in a 1 MWe field test at Dupont's Martinsville plant. The proposed demonstration will also be done at the Edgewater Station and provide a side-by-side comparison with LIMB.

PROJECT SUMMARY

PROPOSER:	Coal Tech Corporation
PROJECT TITLE:	Advanced Cyclone Combustor Demonstration
PROJECT LOCATION:	Williamsport, Pennsylvania -- Lycoming County
TECHNOLOGY:	Advanced Air-Cooled Slagging Cyclone Combustor with Limestone Addition for SO_2 Control
APPLICATION:	Industrial and Utility Boilers; New or Retrofit; Coal, Oil, or Gas Designed
PRODUCT:	Steam and/or electricity
TYPE OF COAL USED:	Utah Black Mesa Sub-bituminous, Pennsylvania Bituminous - Freeport Seam (2-4%S)
PROJECT SIZE:	1 ton/hr coal feed to combustor
PROJECT STARTING DATE:	10/01/86
PROJECT DURATION:	27 months
COST SHARING:	Average Participant Share - 50% Average DOE Share - 50%
PROPOSED CO-FUNDERS:	Coal Tech Corporation Pennsylvania State Energy Development Authority Southern California Edison Pennsylvania Power and Light Keeler Boiler Manufacturing Company

PROJECT DESCRIPTION:

The proposed project is for a 1,000 hour test to demonstrate the performance of an advanced, air-cooled, cyclone combustor with dry pulverized coal. Two Pennsylvania bituminous coals, containing 2 percent and 3 to 4 percent sulfur, and one Utah sub-bituminous coal, containing 0.5 percent sulfur, will be combusted to demonstrate that this advanced combustor is capable of burning a variety of United States' coals in an environmentally acceptable manner. The technical performance objectives of the proposed project are to demonstrate: (1) 90 to 95 percent coal ash retention in the combustor (and subsequent rejection), (2) NO_x reductions to 100 ppm or less, (3) sulfur oxide emission reductions of 70 to 90 percent, and (4) combustor durability and flexibility.

The combustor can be adapted to retrofit boilers as well as new; it can be used for converting coal and gas designed boilers to coal; and it has industrial and utility applications.

The Coal Tech Corporation is now constructing a 30 MBtu/hr (1 ton/hr) combustor which is nearing completion. The proposed demonstration project will be conducted at the Keeler Boiler Company/Dorr Oliver, Williamsport, Pennsylvania, site where a 23 MBtu/hr D-tube package boiler designed for oil is available. The demonstration will conclude in 27 months.

PROJECT SUMMARY

PROPOSER:	Energy & Environmental Research Corporation
PROJECT TITLE:	Gas Reburning/Sorbent Injection
PROJECT LOCATION:	Bartonville, Illinois -- Peoria County Hennepin, Illinois -- Putnam County Springfield, Illinois -- Sangamon County
TECHNOLOGY:	Flue gas cleanup by gas reburning for NO_x control and sorbent injection (LIMB) for SO_x control.
APPLICATION:	Utility, industrial boilers--retrofits
PRODUCT:	Environmental control technology
TYPE OF COAL USED:	Illinois bituminous
PROJECT SIZE:	117 MWe, 80 MWe, 40 MWe boilers (three sites)
PROJECT STARTING DATE:	01/01/87
PROJECT DURATION:	48 months
COST SHARING:	Average Participant Share - 50% Average DOE Share - 50%
PROPOSED CO-FUNDERS:	Gas Research Institute State of Illinois

PROJECT DESCRIPTION:

The EER Corporation in conjunction with the Gas Research Institute and the State of Illinois proposes to demonstrate a combination of gas reburning and sorbent injection for the control of SO_2 and NO_x emissions from existing coal-fired boilers. Program goals are 60 percent NO_x control and 50 percent SO_2 control. Reburning is achieved by injection of natural gas (10 to 20 percent of the total fuel input) above the normal furnace heat release zone to produce an oxygen deficient region in the upper furnace (reburning zone). Burnout air is introduced above the reburning zone to complete the fuel combustion. A portion of the NO_x produced in the main heat release zone is decomposed to molecular nitrogen in the reburning zone. Since the reburning fuel contains no sulfur, SO_2 emissions are reduced in proportion to the amount of gas fired. Additional SO_2 emission reductions are obtained by injection of calcium based sorbents either with the burnout air or downstream between the air preheater and the electrostatic precipitator.

Three host sites will be employed representing the three major firing configurations currently employed. These are tangential (Hennepin site), wall fired (Bartonville site), and cyclone (Springfield site). Boiler sizes are 80 MWe, 117 MWe, and 40 MWe, respectively. A 48-month program is proposed with a 60 month period required if phase overlap is omitted.

PROJECT SUMMARY

PROPOSER:	Energy International, Inc.
PROJECT TILE:	UCG/Clean Fuels Proof-of-Concept Project
PROJECT LOCATION:	Rawlins, Wyoming -- Carbon County
TECHNOLOGY:	Underground coal gasification/ indirect liquefaction
APPLICATION:	Refiners and market users of substitute natural gas/synthesis gas/distillate liquids
PRODUCT:	SNG, Clean Distillate Liquids
TYPE OF COAL USED:	Sub-bituminous, Steeply Dipping Bed Coal Seams
PROJECT SIZE:	200 tons of coal per day
PROJECT STARTING DATE:	09/15/86
PROJECT DURATION:	36 months
COST SHARING:	Average Participant Share - 51% Average DOE Share - 49%
PROPOSED CO-FUNDERS:	Energy International Inc. Stearns Catalytic Corporation Rocky Mountain Energy Company Western Research Institute Gas Research Institute

PROJECT DESCRIPTION:

A proof-of-concept/pilot demonstration of the U.S. DOE developed Steeply Dipping Bed (SDB) underground coal gasification (UCG) technology applied to the sub-bituminous coal deposits of Wyoming is proposed. The pilot demonstration unit will be at the same general location (Rawlins) as previous tests and will operate for 180 days, gasify 36,000 tons of coal and produce up to 2,000-4,000 barrels of middle distillate liquids using a fixed bed indirect liquefaction technology. The commercial plant to follow (of which the proposed demonstration represents the first module) will produce 4,000 bbl/day of middle distillate transportation liquids and 60,000,000 scf/day of SNG. The proposers include the technical UCG team, formerly with Gulf, the engineering firm (Stearns Catalytic) who has operated several past DOE UCG field tests, and a coal-owner/energy-user (Rocky Mountain Energy).

PROJECT SUMMARY

PROPOSER:	General Electric Company
PROJECT TITLE:	Integrated Gasification-Steam Injected Gas Turbine
PROJECT LOCATION:	Evandale, Ohio -- Hamilton County Dunkirk, New York -- Chautauqua County
TECHNOLOGY:	IG-STIG with Hot Gas Cleanup
APPLICATION:	Utility, Industrial
PRODUCT:	Electricity, steam
TYPE OF COAL USED:	Eastern Bituminous
PROJECT SIZE:	50 MW and 5 MW
PROJECT STARTING DATE:	01/02/87
PROJECT DURATION:	60 months
COST SHARING:	Average Participant Share - 50% Average DOE Share - 50%
PROPOSED CO-FUNDERS:	General Electric Company Niagra Mohawk Power Corporation Peabody Holding Company Burlington Northern Railroad Ohio Department of Development Empire State Electrical Energy Research Corporation New York Energy Research Development Authority

PROJECT DESCRIPTION:

The project will use an integrated coal gasification, steam-injected gas turbine power plant to demonstrate the feasibility of simplified gasification systems for commercial coal-to-electricity applications. The simplified system is configured to reduce components in each of the major subsystems; gasification; gas cleanup, and gas turbine power generation system, while retaining commercial hardware and design philosophy for many of the subsystem components. The technology uses an air-blown moving bed gasifier, zinc-ferrite sulfur removal technology, hot cyclones, and the "LM" series (aircraft derivative) gas turbine/generator package. Key elements are the high-temperature gas cleanup systems which can allow significant reduction in the contaminant levels without degradation of plant efficiency. The system will be demonstrated at different sizes at the two site locations; a 5 MW plant at the Dunkirk Station of the Niagara Mohawk Power Corporation and a 50 MW plant at the General Electric Evondale Plant.

PROJECT SUMMARY

PROPOSER:	The M. W. Kellogg Company
PROJECT TITLE:	The Appalachian Project
PROJECT LOCATION:	Cairnbrook, Pennsylvania -- Somerset County
TECHNOLOGY:	Integrated Gasifier Combined Cycle Turbine System with Hot Gas Cleanup
APPLICATION:	Utility
PRODUCT:	Electricity
TYPE OF COAL USED:	High sulfur, Eastern bituminous, coals
PROJECT SIZE:	60 MW
PROJECT STARTING DATE:	10/01/86
PROJECT DURATION:	63 months
COST SHARING:	Average Participant Share - 50% Average DOE Share - 50%
PROPOSED CO-FUNDERS:	M. W. Kellogg Company KRW Energy Systems Inc. Westinghouse Electric Corporation General Electric Company Pennsylvania Electric Company

PROJECT DESCRIPTION:

The proposed project is for the purpose of demonstrating an advanced integrated coal gasification combined cycle (IGCC) system. The project will feature the Kellogg-Rust Westinghouse (KRW) ash agglomerating fluidized-bed gasification process using in-bed desulfurization with advanced "hot gas cleanup" for particulate and sulfur control, and a General Electric MS6001 gas turbine combined cycle power system. One such KRW gasifier operating in the air-blown mode with in-bed desulfurization and hot gas cleanup technology will convert 485 tons per day of bituminous coal into a low-Btu fuel gas for use in an advanced combustion turbine generator, coupled into a heat recovery steam generator. The steam generated from the combustion turbine exhaust and from the gasifier product gas heat recovery will be fed to a steam turbine generator.

The nominal 60 MW demonstration project managed by Appalachian Mountain Coal Development Company (AMCOAL), a special purpose company formed by Kellogg and General Electric to demonstrate and commercialize the technology, will feature a hot gas cleanup system which delivers fuel gas at 1,000°F - 1,200°F to the combustion turbine, thus avoiding costly inefficient low pressure cleanup processes. This is made possible by the use of in-bed desulfurization and hot-sulfur removal polishing step which uses a zinc ferrite sorbent bed. Particles will be removed by the use of a sintered metal filter.

The system, once it has been demonstrated, will be highly efficient with heat rates around 7,800 Btu/kWhr at a capital cost of approximately $1,000 per kW. Various sizes can be implemented by using the 60 MW module that will be demonstrated in the overall system. Other applications for the system are cogeneration and retrofit of combustion turbines and gas-fired combined cycles.

PROJECT SUMMARY

PROPOSER:	Ohio Ontario Clean Fuels Inc. Stearns Catalytic Corporation HRI, Inc.
PROJECT TITLE:	Prototype Coal-Petroleum Coprocessing Plant
PROJECT LOCATION:	Warren, Ohio -- Trumbull County
TECHNOLOGY:	Coal-Petroleum Coprocessing
APPLICATION:	All Markets
PRODUCT:	Clean Distillate Liquid
TYPE OF COAL USED:	Ohio #5 & #6; Alternate coal may be used
PROJECT SIZE:	Will process 800 tpd of coal plus sufficient residual oil to yield 11,750 BPD of clean distillate liquid
PROJECT STARTING DATE:	08/01/86
PROJECT DURATION:	52 months
COST SHARING:	Average Participant Share - 80.1% Average DOE Share - 19.9%
PROPOSED CO-FUNDERS:	Ohio Ontario Clean Fuels Inc. Stearns Catalytic Corporation HRI, Inc.

PROJECT DESCRIPTION:

The proposed project is a prototype commercial coal/oil coprocessing plant to be located in Warren, Ohio. This plant will convert high sulfur, high nitrogen, Ohio bituminous coal and poor-quality petroleum residua to produce 11,750 barrels per day of clean liquid fuels. The process to be utilized in the project is Coal/Oil Co-Processing, utilizing HRI's proprietary ebullated-bed reactor technology. In this process clean liquid fuels are produced from coal, petroleum residuum, and natural gas. The ebullated-bed H-oil process has been operated commercially. Coal is blended with residual oil in the process and both are simultaneously converted to clean distillate fuels. A "typical" C4-975^{o}F distillate fuel will contain 0.1 percent sulfur and 0.2 percent nitrogen. The prototype plant will process 800 tons per day of coal, plus residual sufficient to yield 11,750 barrels per day of distillate product.

PROJECT SUMMARY

PROPOSER:	Weirton Steel Corp.
PROJECT TITLE:	Kohle Reduction (KR) Ironmaking Demonstration Plant
PROJECT LOCATION:	Weirton, West Virginia -- Hancock County
TECHNOLOGY:	Production of pig iron from iron ore and coal in a melter/gasifier using the Korf Engineering KR (or Corex) process
APPLICATION:	Industrial ironmaking operations
PRODUCT:	Metal
TYPE OF COAL USED:	Low volatile coal and coal blends from West Virginia, Pennsylvania and Ohio
PROJECT SIZE:	330,000 tons/yr. hot metal
PROJECT STARTING DATE:	01/01/87
PROJECT DURATION:	55 months
COST SHARING:	Average Participant Share - 64.6% Average DOE Share - 35.4%
PROPOSED CO-FUNDER:	Weirton Steel Company

PROJECT DESCRIPTION:

The Kohle Reduction (KR) process, developed by Korf Engineering (a West German Company), replaces the two-step coke oven/blast furnace approach to producing pig iron from iron ore and metallurgical coal with an integrated two component oxygen-blown blast furnace system capable of operation on a variety of U.S. coals. The system consists of an upper "reduction shaft" and a lower "melter-gasifier" component. Iron ore, along with an appropriate flux (e.g., limestone), is fed into the off-gas from the lower melter-gasifier section. The lower section is an oxygen-blown fluidized-bed coal gasifier. In this section the sponge iron is melted and the resulting pig iron and slag are separated and tapped as in a blast furnace. The low/medium-Btu, sulfur-free off-gas from the process (sulfur is captured by the limestone and remains in the slag) is scrubbed to remove particulates and is available for site use.

The proposed project calls for the design and construction of a 330,000 ton (iron) per year demonstration plant at the Weirton Steel plant in Weirton, West Virginia, and operation of the plant on a variety of U.S. feedstocks. The size represents a scale-up of five over the pilot plant where the basic process operability on U.S. feedstocks was demonstrated.

APPENDIX B

Excerpts from the Joint Report of the Special Envoys

In preparing our recommendations to both governments, we have been conscious of the wide differences between our two countries on this issue, differences that are based not just on perception but also on certain underlying political, social, economic, and geographic realities. We have also kept in mind that our mandate was not to find a final solution to this bilateral problem, but to find ways in which our two countries can begin to move together to deal effectively with this vexing issue.

Both nations want to see progress on acid rain. For such progress to be possible, and if it is to result in part from the work of the Special Envoys, our recommendations must be realistic. They must not ask either country to make a sudden, revolutionary change in its position. They must not call for immediate abandonment of major policy stands. They must instead point the way to a resumption of fruitful bilateral dialogue and constructive action that will help us relieve the stress that this issue has created, and reduce the flow of airborne pollutants across our common borber.

A. Innovative Control Technologies

A significant impediment to the development of a U.S. consensus on acid rain is the high cost of the available control options. Because the impacts of different options fall on different interest groups, political positions have become polarized, and it has become increasingly difficult to find a common ground for action. If the menu of control options were expanded, and if the new options were significantly cheaper yet highly efficient, it would be easier to formulate an acid rain control plan that would have broader public appeal.

Recommendation

Therefore, the U.S. government should implement a five-year, five-billion-dollar control technology commercial demonstration program. The federal government should provide half the funding -- 2.5 billion dollars -- for projects which industry recommends, and for which industry is prepared to contribute the other half of the funding.

Because this technology demonstration program is meant to be part of a long-term response to the transboundary acid rain problem, prospective projects should be evaluated according to several specific criteria. The federal government should co-fund projects that have the potential for the largest emission reductions, measured as a percentage of SO2 and NOx removed. Among projects with similar potential, government funding should go to those that reduce emissions at the cheapest cost per ton. More

consideration should be given to projects that demonstrate retrofit technologies applicable to the largest number of existing sources, especially existing sources that, because of their size and location, contribute to transboundary air pollution. In short, although the primary purpose of this research program is to demonstrate the kinds of technologies that would be needed for any future acid rain control program, it should also result in some near-term reductions in U.S. air emissions that affect Canadian ecosystems.

Furthermore, special consideration should be given to technologies that can be applied to facilities currently dependent on the use of high-sulfur coal. Because the scrubbers currently available to clean high-sulfur coal are very expensive, there is an economic incentive for sources to switch to low-sulfur coal as a method of reducing emissions. However, coal-switching imposes significant socio-economic costs on high-sulfur coal miners, their families, and their communities. The commercial demonstration of innovative technologies that clean high-sulfur coal will help to reduce the economic consequences of any future acid rain control program.

We further recommend that a panel, headed by a senior U.S. cabinet official, be established to oversee this research demonstration program and select the projects to be co-funded by the federal government. The U.S. Environmental Protection Agency and Department of Energy should provide the technical expertise necessary to select demonstration projects. Other members of the panel should be drawn from the Department of State and state governments. Canada also should be invited to send a representative to sit on this panel.

In this connection, we note a somewhat similar approach being taken in Canada. There, the major industrial sources of acidic emissions are smelters. As part of the Canadian acid rain mitigation program, federal and provincial governments are co-operating financially with industry to develop and implement advanced technologies designed to improve smelter efficiency and reduce pollution.

Recommendation

The results of the Canadian technology development program should be shared with the United States.

Recommendation

Acid rain should remain high on the agenda of meetings between the President and Prime Minister. They should be prepared to intercede personally from time to time to resolve difficulties and ensure progress. The U.S. cabinet official heading the technology development panel and a Canadian cabinet official would jointly advise the President and Prime Minister.

CONFERENCE REPORT (H. REP. 99-450)

Conference Rep. on Pub. L. 99-190
Making Further Continuing Appropriations
for Fiscal Year 1986, and for Other Purposes

TITLE II - Related Agencies

DEPARTMENT OF THE TREASURY
Energy Security Reserve
(Including Rescission)

The managers agree to rescind all funds appropriated to the Energy Security Reserve except $400,000,000 for a clean coal technology program to be administered by the Secretary of Energy in the Department of Energy, and $10,000,000 for expenses incidental to the closing of the Synthetic Fuels Corporation (SFC). Of the $400,000,000, $100,000,000 will be immediately available, $150,000,000 will be available beginning on October 1, 1986, and $150,000,000 will be available beginning on October 1, 1987. The remaining funds in the "Clean Coal Technology Reserve" are reduced to $350,000,000.

DEPARTMENT OF ENERGY
Clean Coal Technology

The managers have agreed to a $400,000,000 Clean Coal Technology program as described under the Department of the Treasury, Energy Security Reserve. Bill language is included which provides for the selection of projects no later than August 1, 1986. Within that period, a general request for proposals must be issued within 60 days and proposals must be submitted to the Department within 60 days after issuance of the general request for proposals. Language is also included allowing the Secretary of Energy to vest title in interests acquired under agreements in any entity, including the United States, and delineating cost-sharing requirements. Funds for these activities and projects are made available to the Clean Coal Technology program in the Energy Security program.

It is the intent of the managers that contributions in the form of facilities and equipment be considered only to the extent that they would be amortized, depreciated or expensed in normal business practice. Normal business practice shall be determined by the Secretary and is not necessarily the practice of any single proposer. Property which has been fully depreciated would not receive any cost-sharing value except to the extent that it has been in continuous use by the proposer during the calendar year immediately preceding the enactment of this Act. For this property, a fair use value for the life of the project may be assigned. Property offered as a cost-share by the proposer that is currently being depreciated would be limited in its cost-share value to the depreciation claimed during the life of the demonstration project. Furthermore, in determining normal business practice, the Secretary should not accept valuation for property sold, transferred, exchanged, or otherwise manipulated to acquire a new basis for depreciation purposes or to establish a rental value in circumstances which would amount to a transaction for the mere purpose of participating in this program.

The managers agree that, with respect to cost-sharing, tax implications of proposals and tax advantages available to individual proposers should not be considered in determining the percentage of Federal cost-sharing. This is consistent with current and historical practices in Department of Energy procurements.

It is the intent of the managers that there be full and open competition and that the solicitation be open to all markets utilizing the entire coal resource base. However, projects should be limited to the use of United States mined coal as the feedstock and demonstration sites should be located within the United States.

The managers agree that no more than $1,500,000 shall be available in FY 1986 and $2,000,000 each year thereafter for contracting, travel, and ancillary costs of the program, and that manpower costs are to be funded under the fossil energy research and development program.

The managers direct the Department, after projects are selected, to provide a comprehensive report to the Congress on proposals received.

The managers also expect the request for proposals to be for the full $400,000,000 program, and not only for the first $100,000,000 available in fiscal year 1986.

TITLE III - General Provisions

Section 325

A new section 325 is included which provides a 0.6 percent reduction for budget authority included in the bill for payments not required by law, and for amounts available for the Clean Coal Technology Program in the Energy Security Reserve. The reduction must be taken ratably for each program, activity, and project provided for in the Act.

SENATE REPORT 99-141
(To accompany H.R. 3011)

Department of the Interior and Related Agencies Appropriation Bill, 1986

DEPARTMENT OF ENERGY

CLEAN COAL TECHNOLOGY RESERVE

1985 appropriation	
1986 budget estimate	
House allowance (by transfer):	
1986	($100,000,000)
1987	(200,000,000)
1988	(200,000,000)
Committee recommendation:	
1986	100,000,000
1987	(175,000,000)
1988	(300,000,000)
1989	(175,000,000)

The Committee recommends an appropriation of $100,000,000 in fiscal year 1986 for the Clean Coal Technology Program as well as advance appropriations of $175,000,000, $300,000,000, and $175,000,000 for fiscal year 1987, fiscal year 1988, and fiscal year 1989 respectively. This program was established by Public Law 98–473 "for the purpose of conducting cost-shared clean coal technology projects for the construction and operation of facilities to demonstrate the feasibility for future commercial operation." Pursuant to section 321 of that act, the Department solicited statements of interest in clean coal projects and received 175 responses.

The Committee has not agreed to the transfer of funds from moneys available to the Synthetic Fuels Corporation to the Department of Energy to initiate the Clean Coal Technology Program as proposed by the House, but has instead recommended the multiyear appropriations of new budget authority now. This approach is intended to ensure industry of a firm Federal commitment to a $750,000,000 program. Removing the uncertainty of future funding will reduce apparent risk to the private sector and should help the Government negotiate more favorable cost-sharing arrangements. Clear Federal commitment will stimulate greater competition and likely produce better projects. Also, the provision of multiyear funding is intended to be a strong congressional signal that the Department of Energy is expected to enter into multiyear contracts with project sponsors.

In addition to making advance appropriations, as noted previously, the Committee has recommended bill language requiring the Secretary to issue a general solicitation for clean coal projects within 30 calendar days after enactment of this legislation, to close this solicitation within 60 days, and to select projects for awards 90 days thereafter. Language proposed by the House relating to levels and forms of cost sharing have been retained in the bill. Earlier project selection criteria which were contained in Senate Report 99–82 on the fiscal year 1985 supplemental appropriations bill and which were modified in the statement of the managers, House Report 99–236, continue in force.

99TH CONGRESS *1st Session* | HOUSE OF REPRESENTATIVES | REPORT 99-205

DEPARTMENT OF THE INTERIOR AND RELATED AGENCIES APPROPRIATION BILL, 1986

[To accompany H.R. 3011]

DEPARTMENT OF ENERGY

CLEAN COAL TECHNOLOGY RESERVE

(TRANSFER OF FUNDS)

Appropriation, 1985	.....
Budget estimate, 1986	.....
Recommended, 1986	($100,000,000)
Comparison:	
Appropriation, 1985	(+100,000,000)
Budget estimate, 1986	(+100,000,000)
Recommended, 1987	(300,000,000)
Recommended, 1988	(350,000,000)

The clean coal technology reserve was established by Public Law 98–473, the Act making continuing appropriations for fiscal year 1985. At the same time, the law required the Department of Energy to solicit "statements of interest in, and proposals for projects employing emerging clean coal technologies". The response to the Department's solicitation was impressive, with over 170 responses received even though respondents were aware that no funding was available.

There appears to be a consensus building that some government impetus is necessary to assist in the development of technologies beyond the scale of the ongoing research and development programs in the Department of Energy. At the same time, it is apparent that very large scale facilities of the type originally envisioned to be sponsored by the Synthetic Fuels Corporation (SFC) will require too large a subsidy to attract either government or industry

interest. This is evidenced by the SFC's stated intent to reduce the scale and adjust the support of candidate projects before the Corporation.

The foregoing situation, combined with the need to develop technologies that will use coal cleanly, either for power generation or to fuel other equipment or vehicles, leads the Committee to recommend the transfer of $750,000,000 from the funds available to the Synthetic Fuels Corporation to the Department of Energy for clean coal technology. The funds are to be derived from the $5.7 billion currently available for projects for which Letters of Intent were authorized on or before June 1, 1984.

Air pollution, particularly acid rain, is a problem of growing concern in the Nation. In addition, significant new generating capacity will be required by utilities in the 1990's. In view of the collapse of the nuclear construction industry, the only viable alternative appears to be coal-fired plants. Therefore, it becomes imperative to demonstrate technologies that use coal cleanly and efficiently, so that needed generating capacity will be available on time, and with minimal environmental impact. Technologies that can be retrofitted to existing applications of coal will also provide pollution relief. Clean uses of coal in other applications will also reduce dependence on foreign oil as well as increase coal markets.

In order to show the long-term commitment of the Congress to this program, appropriations are recommended for three years; $100,000,000 for fiscal year 1986, $300,000,000 to become available in fiscal year 1987, and $350,000,000 to become available in fiscal year 1988. The Committee believes such an action is necessary in order to assure serious industry proposals with concomitant commitments, including cost-sharing. Staging the availability also allows for orderly review of the program.

The Committee believes that projects in this program should be industry projects assisted by the government, and not government directed demonstrations. To emphasize this view the Committee has included a requirement that government funding not exceed 50% of project cost. The Committee also has included provisions related to cost-sharing to provide that:

(1) Project sponsors must cost-share in each phase of the project.

(2) If the government participates in sharing costs above the original estimate, it may not be in a greater proportion than was shared originally and then only up to 25% of the original amount of assistance.

(3) Future considerations such as royalties and revenue sharing from other plants or operations are not considered cost-sharing. The Department is, however, encouraged to negotiate such considerations if possible.

(4) Other appropriated Federal funds are not considered cost-sharing.

(5) In-kind contributions, such as supplies, equipment, facilities, and previously expended research and development funds will only be considered cost-sharing to the extent that they would be expensed, amortized, or depreciated in normal business practice. Thus, for example, fully depreciated or amortized investments would not be considered cost-sharing, nor would supplies previously expensed against income rather than placed in inventory.

The Committee believes that the above cost-sharing provisions will lead to carefully considered proposals from industry because industry will be required to provide significant funds of its own from the beginning of the project. This was a failing of the original Department demonstration program and many of its large scale pilot facilities.

Finally, the Committee has included a requirement for the Department to issue a general request for proposals within 90 days of enactment of the Act, and then move promptly into the contract process. As a result of the informational proposals received pursuant to the continuing resolution in fiscal year 1985, sufficient prior work has been done so that the process can proceed expeditiously. The Committee expects a full and open competition and has not favored any technology or project.

Many sources in Congress and elsewhere have been suggesting technical or procedural criteria for the selection of projects, and in general, the criteria suggested appear reasonable. The Committee observes that the criteria tend to concentrate on utility applications, and believes that although these are very important, other applications such as industrial, including steel and iron ore processing, and transportation uses are also of interest. The preparation of clean coal fuels is also important in itself.

The Committee believes that this program can be a significant step in reducing the environmental effects of coal burning, in increasing power generation options, in introducing new coal burning equipment, and in increasing markets for coal and coal-derived products, which will offset oil imports in the future.

CONFERENCE REPORT (H. REPT. 99-236)

CONFERENCE REPORT ON PUB. L. NO. 99-88,

MAKING SUPPLEMENTAL APPROPRIATIONS FOR THE FISCAL YEAR ENDING SEPTEMBER 30, 1985, AND FOR OTHER PURPOSES

DEPARTMENT OF ENERGY

CLEAN COAL TECHNOLOGY

The managers agree with the clean coal technology project guidelines contained in Senate Report 99-82 with the following modifications:

I. GENERAL PROJECT GUIDELINES:

2. The project should utilize or expand the utility of technologies, techniques or processes which do not duplicate a commercial scale demonstration currently being conducted in the United States.

3. The clean coal technology, alone or in conjunction with other technologies, must result in emission levels that comply with or exceed Clean Air Act requirements, in a cost-effective manner.

and,

IV. ENVIRONMENTAL BENEFITS:

1. The commercial application of the clean coal technology for retrofit applications on fossil fuel-fired plants is likely to result in a reduction of emissions from the use of coal at a cost which is competitive with the cost of achieving comparable emission reductions by current technology.

The managers agree that the clean coal technology project criteria contained in the Senate report provide useful guidance for the development of a competitive solicitation for cost-shared clean coal technology projects, and that the Department of Energy should immediately begin preparing such a solicitation document so that it can be issued as soon as possible after the beginning of fiscal year 1986, if funds are provided. To the extent that technologies traditionally supported by the Environmental Protection Agency (EPA) are part of the solicitation or responses to it, as well as on environmental regulatory considerations, the Department should consult with EPA.

99TH CONGRESS } SENATE { REPORT
1st Session } { 99-82

SUPPLEMENTAL APPROPRIATIONS BILL, 1985

REPORT

[To accompany H.R. 2577]

DEPARTMENT OF ENERGY

FOSSIL ENERGY RESEARCH AND DEVELOPMENT

The Committee has developed the following clean coal technology project criteria in an effort to assist the Department in establishing criteria for eventual project selection, in the event that clean coal technology funds are appropriated. The Committee urges the Department to begin preparation of a competitive solicitation for clean coal technology demonstrations so that fiscal year 1986 funds, if provided, can be obligated in a timely manner.

In conducting the solicitation, the Committee expects that it will be a full and open competition. The Committee further anticipates that the solicitation will be open to all market applications utilizing the entire coal resource base. Consideration also should be given to heavily regulated electric utilities and related industrial boiler markets. Eventual project selection should not be duplicative of current marketplace activities. The Committee considers the following criteria as representative of those to be used by the Department in the evaluation of proposals received under a full and open competitive solicitation.

I. General project guidelines:

1. The project must demonstrate commercial feasibility of the technology or process and be of commercial scale or of such size as to permit rapid commercial scaleup.
2. The project should utilize technologies, techniques or processes which do not duplicate a commercial scale demonstration currently being conducted in the United States.
3. The clean coal technology must result in emission levels that comply with or exceed Clean Air Act requirements, in a cost-effective manner.
4. The technology to be demonstrated should be available for commercial application no later than the 1990's.
5. The project sponsor(s) must be willing to commit at least 50 percent cost sharing including, but not limited to, project sponsor funds or other resources. In determining the degree of Federal sponsorship, the Government should take into account the total estimated costs of the project and the degree of risks and ultimate benefits associated with the technology.
6. The project sponsor(s) must have relevant experience and possess the capability and resources to assure the project is properly engineered, constructed and operated.

II. Subsequent applicability of the technology:
    1. The clean coal technology to be demonstrated in either new or retrofit applications must provide significant potential for replication.
    2. The project must provide useful technical, environmental, operational, performance, and economic data to reduce the uncertainties of subsequent commercial scale utilization of the technology.

III. Technical feasibility:
    1. Sufficient technical data (including data developed from pilot plant operations, if any) should be available to determine that the demonstration will have a significantly high probability of success.
    2. The technology should have been successfully tested at the bench scale or subsequent stage of development.

IV. Environmental benefits:
    1. The commercial application of the clean coal technology for retrofit applications on coal-fired plants is likely to result in a reduction of emissions at a cost which is competitive with the cost of achieving that reduction by current technology.
    2. The commercial application of the clean coal technology for precombustion cleanup shall result in reductions in sulfur and ash content which will allow compliance with emissions requirements in a cost-effective manner.
    3. The commercial application of the technology for new applications shall achieve emission levels equal to or better than the new source performance standards for that source category in a cost-effective manner.
    4. The amounts and characteristics of waste products must be identified and processes for proper handling and disposal (or utilization or regeneration) in an environmentally acceptable manner must be in the project proposal.

V. Economic feasibility:
    1. The projected commercial application should be economically attractive.
    2. The project, where appropriate, should include characteristics which permit modularity, shop fabrication of transportable components, operating flexibility or maintainability and reliability of units, or other characteristics which permit shortened construction periods or lower overall capital costs for subsequent commercial projects.

JOINT RESOLUTION
Making continuing appropriations for the Fiscal Year 1985, and for other purposes.

DEPARTMENT OF THE TREASURY

ENERGY SECURITY RESERVE

(RESCISSION)

Provided further, That of the $5,375,000,000 rescinded from the Energy Security Reserve, $750,000,000 shall be deposited and retained in a separate account hereby established in the Treasury of the United States, entitled the "Clean Coal Technology Reserve," which account and the appropriations therefor, shall be available for the purpose of conducting cost-shared clean coal technology projects for the construction and operation of facilities to demonstrate the feasibility for future commercial application of such technology, including those identified in section 320 of the fiscal year 1985 Department of the Interior and Related Agencies Appropriations Act, as reported by the Senate Committee on Appropriations (H.R. 5973, Senate Report 98-578), without fiscal year limitation, subject to subsequent annual appropriation in the Department of the Interior and Related Agencies Appropriations Act.

TITLE III—GENERAL PROVISIONS

SEC. 321. The Secretary of Energy pursuant to the Federal Nonnuclear Energy Research and Development Act of 1974 (Public Law 93-577), shall—

(1) no later than sixty days after the date of the enactment of this Act, publish in the Federal Register a notice soliciting statements of interest in, and proposals for projects employing emerging clean coal technologies, which statements and proposals are to be submitted to the Secretary within ninety days after the publication of such notice; and

(2) no later than April 15, 1985, submit to Congress a report that analyzes the information contained in such statements of interest and proposals, assesses the potential usefulness of each emerging clean coal technology for which a statement of interest or proposal has been received, and identifies the extent to which Federal incentives, including financial assistance, will accelerate the commercial availability of these technologies.

98TH CONGRESS } SENATE { REPORT
2d Session } { 98-578

DEPARTMENT OF THE INTERIOR AND RELATED AGENCIES APPROPRIATION BILL, 1985

REPORT

[To accompany H.R. 5973]

The Committee has observed with disappointment the retreat from private sector plans for development of synthetic fuels over the last few years. Clearly there are many reasons why synthetic fuel technologies are not being commercialized at even a small fraction of the rate envisioned when the Energy Security Act was passed in 1980; among these are the lower than anticipated cost of alternative fuel resources in the near term, the higher than anticipated costs of some developing technologies, and the difficulty in raising the large capital sums required during a period of high interest rates.

The overriding requirement to make this Nation's abundant supplies of coal, oil shale, and other resources available for use in an environmentally acceptable manner continues to be of high priority to the Committee. It is our belief that an aggressive, ongoing program of research, development, and where appropriate, testing, is essential to improve process efficiency, reduce capital costs, and enhance environmental performance of the various synthetic and other fossil energy technologies. The recommended program supports these goals and is necessary to help insure the energy security and energy independence of this Nation.

The Committee has included a provision, section 320 of the general provisions, directing the Secretary of Energy to solicit statements of interest and proposals from the private sector for projects employing emerging clean coal technologies. The purpose of this provision is to—

(1) Identify emerging clean coal technologies that may be commercialized in the near term for reducing emissions from new and existing coal-burning powerplants and from industrial coal uses; and

(2) Determine what incentives, including financial assistance, the Federal Government should provide to assure the earliest practicable commercial availability of these emerging clean coal technologies.

These activities of the Secretary are authorized under sections 103 and 107(a) of the Energy Reorganization Act of 1974, and the Federal Nonnuclear Energy Research and Development Act of 1974 (Public Law 93-577).

The Committee intends to base fiscal year 1986 appropriations decisions on funding for new projects under Public Law 93-577 on the results of this solicitation.

Emerging clean coal technologies are technologies for using coal in electric utility and large industrial applications that reduce sulfur and other emissions resulting from such uses to levels that are required, or may be required, for compliance with the Clean Air Act, as amended.

Examples of such emerging clean coal technologies include, but are not limited to the following: (1) advanced coal preparation and cleaning; (2) limestone injection multistage burners [LIMB]; (3) flue gas desulfurization processes that produce only dry discharges; (4) regenerable flue gas desulfurization; (5) furnace retrofit of in-boiler sulfur control technology; (6) atmospheric fluidized bed combustion systems of a size appropriate to the electric utility market; (7) repowering applications of a pressurized fluidized bed in a large oil-fired boiler; (8) phosphoric acid fuel cell systems using coal-derived gas; (9) coal-fired gas turbines in second-generation combined-cycle systems; and (10) low cost, easily replicable, sources of fuel gas for multimarkets.

Proposed projects solicited under this provision should be large enough to demonstrate commercial feasibility of the technology or, if not, at least permit rapid scaleup to commercial size.

Statements of interest submitted to the Secretary under this provision shall propose a project employing at least one emerging clean coal technology and shall include: (1) a description of the technology to be employed and of the overall project; (2) a comparison of the proposed project with any similar project or facility in existence; (3) the proposed ownership of the project facility; (4) the projected capital, operating, and testing cost and a schedule for construction and testing of the project facility; (5) the characteristics of the coal to be used; (6) the emissions reductions to be achieved by the facility; (7) the proposed financing of the project, including a statement of any cost sharing or incentives, including any financial assistance, that should be provided by the Federal Government and the justification for such incentives; (8) a statement of the project economics which identifies the assumptions used; and (9) a plan which outlines the uses for the products of the proposed facility.

The Secretary is required to submit to Congress no later than April 15, 1985, a report analyzing the information received in the statements of interest and proposals under this provision, assessing the potential usefulness of each technology for which a statement of interest or proposal has been received, and identifying the extent to which Federal incentives will accelerate the commercial availability of these technologies for electric utility and large industrial uses of coal.

*U.S. GOVERNMENT PRINTING OFFICE:1986-181-179:50072